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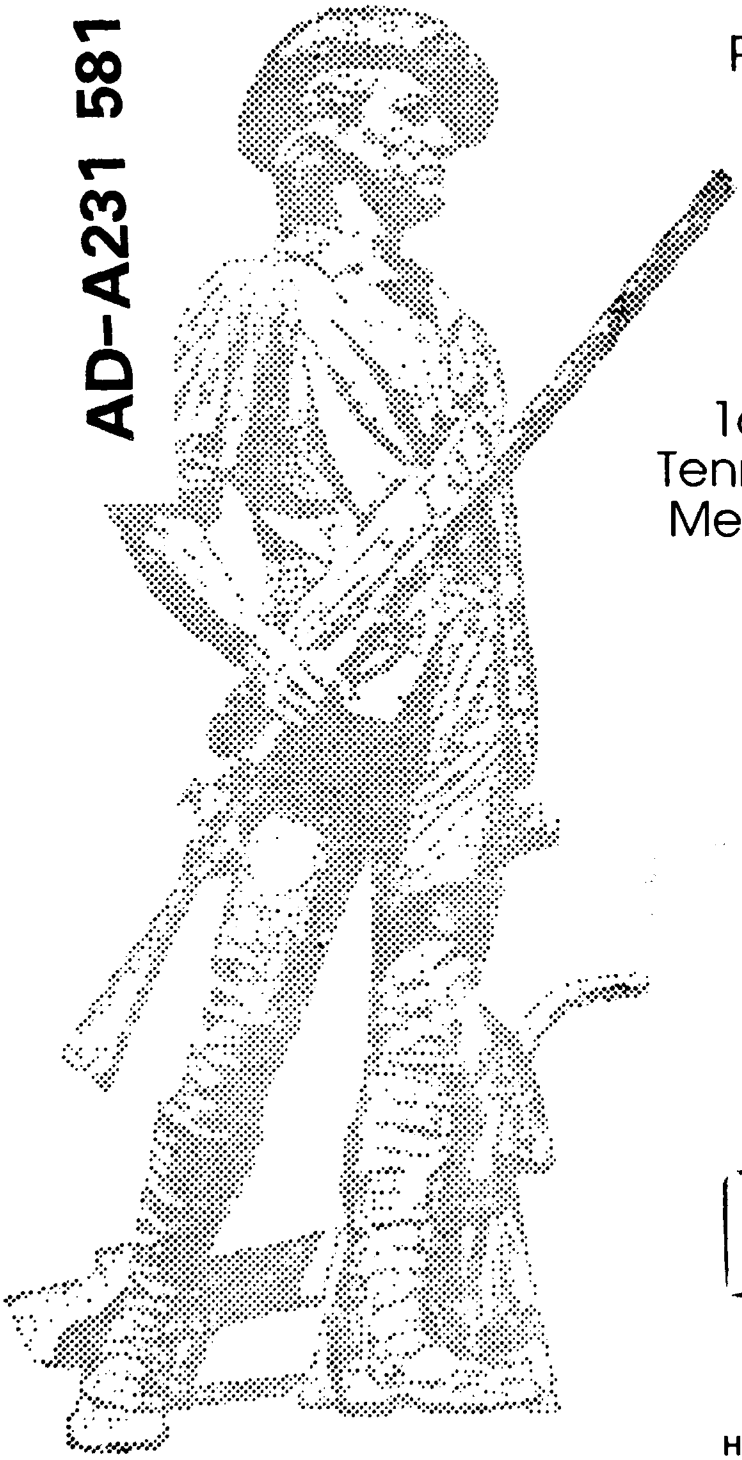
INSTALLATION RESTORATION PROGRAM



Preliminary Assessment

164th Tactical Airlift Group
Tennessee Air National Guard
Memphis International Airport
Memphis, Tennessee

April 1990

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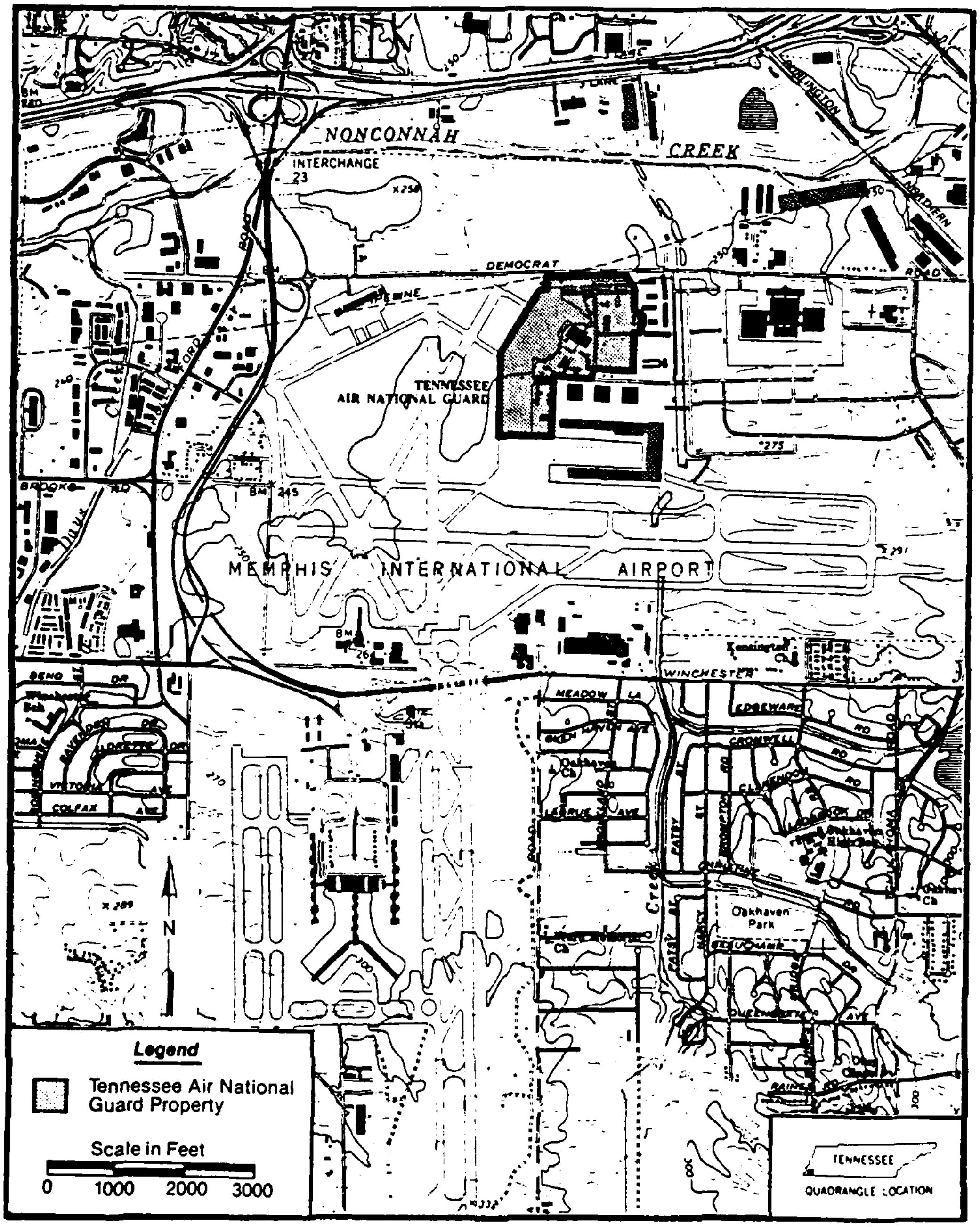

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PRELIMINARY ASSESSMENT

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TENNESSEE AIR NATIONAL GUARD
MEMPHIS INTERNATIONAL AIRPORT
MEMPHIS, TENNESSEE

April 1990

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ACRONYM LIST

AGE	Aerospace Ground Equipment
AMSL	Above Mean Sea Level
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DRMO	Defense Reutilization and Marketing Office
EPA	Environmental Protection Agency
FR	Federal Register
FTA	Fire Training Area
GPM	Gallons Per Minute
HARM	Hazard Assessment Rating Methodology
HAS	Hazard Assessment Score
HM/HW	Hazardous Materials/Hazardous Wastes
HMTC	Hazardous Materials Technical Center
IRP	Installation Restoration Program
MLGW	Memphis Light, Gas, and Water Division
NDI	Non-Destructive Inspection
NGB	National Guard Bureau
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OWS	Oil Water Separator
PA	Preliminary Assessment
PE	Professional Engineer
PG	Professional Geologist
POC	Point of Contact
POL	Petroleum, Oil, and Lubricant
RD&D	Research, Development, and Demonstration
RD/RA	Remedial Design/Remedial Action
SCS	Soil Conservation Service
SI/RI/FS	Site Investigation/Remedial Investigation/Feasibility Study
SPCC	Spill Prevention, Control, and Countermeasures
TAG	Tactical Airlift Group
USAF	United States Air Force
UST	Underground Storage Tank
UTA	Unit Training Assembly

FOREWORD

This Preliminary Assessment (PA) document was originally prepared for the National Guard Bureau (NGB) by the Hazardous Materials Technical Center (HMTC), operated by the Dynamac Corporation. HMTC's contract for conducting PAs ended prior to completion of the final PA document. Subsequently, the NGB requested completion of this PA under an existing contract with the Hazardous Waste Remedial Actions Program (HAZWRAP) Support Contractor Office, operated by Martin Marietta Energy Systems, Inc. for the U.S. Department of Energy. In turn, HAZWRAP subcontracted with Science and Technology, Inc. for completion of the PA document. Science and Technology, Inc. successfully completed this document in April 1990.

Science and Technology, Inc. produced the final document primarily by addressing comments generated by the NGB through review of HMTC draft documents. Since HMTC conducted the PA and prepared the original PA manuscript, the content of this document is principally a reflection of HMTC's efforts.

EXECUTIVE SUMMARY

A. Introduction

The Hazardous Materials Technical Center (HMTC) was retained in March 1988 to conduct the Installation Restoration Program (IRP) Preliminary Assessment (PA) of the 164th Tactical Airlift Group (TAG), Tennessee Air National Guard, Memphis International Airport, Memphis, Tennessee (hereinafter referred to as the Base), under Contract No. DLA 900-82-C-4426. The Preliminary Assessment included:

- o an on-site visit by HMTC personnel during March 7-11, 1988 and interviews with past and present Base employees.
- o the acquisition and analysis of pertinent information and records on hazardous materials use and hazardous waste generation and disposal at the Base;
- o the acquisition and analysis of available geological, hydrological, meteorological, and environmental data from pertinent Federal, State, and local agencies; and
- o the inspection of areas on the Base that may be potentially contaminated with hazardous materials/hazardous wastes (HM/HW).

B. Major Findings

Past Base operations involved the use and disposal of materials and wastes that were subsequently categorized as hazardous. The Base shops and facilities that use and dispose of HM/HW include Aircraft Maintenance, Non-Destructive Inspection (NDI), Aerospace Ground Equipment (AGE), the Photographic Laboratory, Fuels Management, Entomology, Vehicle Maintenance, Air Conditioning/Refrigeration, and the Energy Plant. Waste oils, recovered fuels, spent cleaners, strippers, solvents, acids, photographic chemicals, and hydraulic fluid were generated by activities involving these shops and facilities. The shops and facilities were visited by the Preliminary Assessment team.

A field survey of the Base and interviews with 16 past and present personnel with an average of 17 years of experience at the Base resulted in the identification of no potential sites contaminated by HM/HW.

C. Conclusions

Information obtained through interviews with past and present Base personnel resulted in the identification of no areas on the Base that are potentially contaminated by HM/HW.

D. Recommendations

Based on the findings of this Preliminary Assessment, further IRP investigation is not recommended.

I. INTRODUCTION

A. Background

The 164th Tactical Airlift Group, Tennessee Air National Guard, is located at the Memphis International Airport, Shelby County, Memphis, Tennessee, (hereinafter referred to as the Base). The Base has been leased to the Tennessee Air National Guard since 1959.

Past Tennessee Air National Guard operations at the Base involved the use and disposal of materials and wastes that subsequently were categorized as hazardous. Consequently, the National Guard Bureau has implemented its Installation Restoration Program (IRP), which consists of the following:

- o Preliminary Assessment (PA) - to identify past spill or disposal sites posing a potential and/or actual hazard to public health or the environment.

- o Site Investigation/Remedial Investigation/ Feasibility Study (SI/RI/FS) - to acquire data via field studies for the confirmation and quantification of environmental contamination that may have an adverse impact on public health or the environment and to select a remedial action through preparation of a feasibility study.

- o Research, Development, and Demonstration (RD&D) - if needed, to develop new technology for accomplishment of remediation.

- o Remedial Design/Remedial Action (RD/RA) - to prepare designs and specifications and to implement site remedial action.

B. Purpose

The purpose of this IRP Preliminary Assessment is to identify and evaluate suspected problems associated with past hazardous waste handling procedures, disposal sites, and spill sites on the Base. Personnel from the Hazardous Materials Technical Center (HMTC) visited the Base, reviewed existing environmental information,

analyzed Base records concerning the use and generation of hazardous materials/hazardous wastes (HM/HW), and conducted interviews with past and present Base personnel familiar with past hazardous materials management activities. Relevant information on the following subjects was collected and analyzed as a part of the Preliminary Assessment: history of the Base; past HM/HW management procedures; local geological, hydrological, and meteorological conditions that could affect migration of contaminants; local land use; public utilities that could affect the potential for exposure to contaminants; and ecological settings that indicate environmentally sensitive habitats or evidence of environmental stress.

C. Scope

The scope of this Preliminary Assessment is limited to the operations conducted by the Base and includes:

- o An on-site visit;
- o The acquisition of pertinent information and records on hazardous materials use and hazardous wastes generation and disposal practices at the Base;
- o The acquisition of available geological, hydrological, meteorological, land use, critical habitat, and utility data from various Federal, State, and local agencies;
- o A review and analysis of all information obtained; and
- o The preparation of a report to include recommendations for further actions.

The on-site visit and interviews with past and present personnel were conducted during the period March 7-11, 1988. The Preliminary Assessment was conducted by Mr. Jeffrey Fletcher, Geologist; Ms. Kathryn Gladden, Chemical Engineer; and Mr. Andy Peters, Environmental Scientist. Other HMTC personnel who assisted with the Preliminary Assessment include Ms. Grace Hill, Environmental Scientist; Mr. Raymond Clark, PE/Department Manager, and Mr. Mark Johnson, PG/Program Manager. Their resumes are included as Appendix A. Personnel from the

National Guard Bureau (NGB) assisted in the Preliminary Assessment. They include Mr. Salvador Orochena, Project Officer and Mr. Henry Lowman, Alternate Project Officer. The Point of Contact (POC) at the Base was Major James J. Wilson, Assistant Base Civil Engineer.

D. Methodology

A flow chart of the Preliminary Assessment Methodology is presented in Figure 1. This methodology ensures a comprehensive collection and review of pertinent, site-specific information and is used in the identification and assessment of potentially contaminated hazardous waste spill/disposal sites.

The Preliminary Assessment begins with a site visit to the Base to identify all shop operations or activities on the installation that may use hazardous materials or generate hazardous waste. Next, an evaluation of past and present HM/HW handling procedures at the identified locations is made to determine whether environmental contamination may have occurred. The evaluation of past HM/HW handling practices is facilitated by extensive interviews with past and present employees familiar with the various operating procedures at the Base. These interviews also define the areas on the Base where any waste materials, either intentionally or inadvertently, may have been used, spilled, stored, disposed of, or otherwise released into the environment.

Historic records contained in the Base files are collected and reviewed to supplement the information obtained from interviews. Using this information, a list of past waste spill/disposal sites on the Base is developed. These sites are then subject to further evaluation. A general survey tour of the identified sites, the Base, and the surrounding area is conducted to determine the presence of visible contamination and to help assess the potential for contaminant migration. Particular attention is given to locating nearby drainage ditches, surface water bodies, residences, and wells.

Detailed geological, hydrological, meteorological, land use, and environmental data for the area of study is also obtained from the POC and from appropriate Federal, State, and local agencies. A list of outside agencies contacted is in Appendix B. Following a detailed

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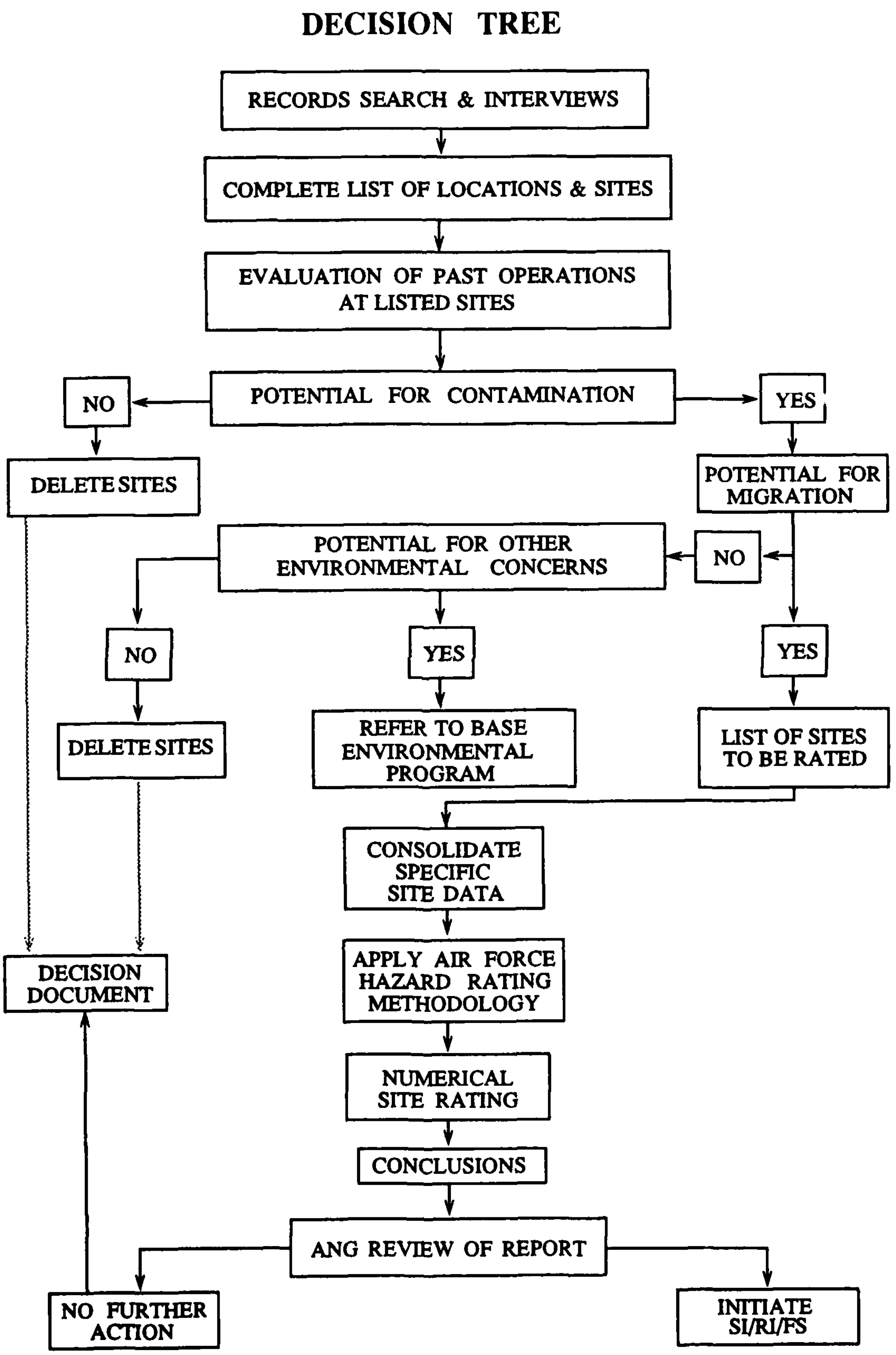
Figure 1.
Preliminary Assessment Methodology Flow Chart



analysis of all the information obtained, areas where HM/HW disposal may have occurred are identified as suspect. Where sufficient information is available, sites are assigned a Hazard Assessment Score (HAS) using the U.S. Air Force Hazard Assessment Rating Methodology (HARM) (Appendix C).

II. INSTALLATION DESCRIPTION

A. Location

The 164th TAG, Tennessee Air National Guard, is located at the Memphis International Airport, Shelby County, Memphis, Tennessee. The airport is located between Airways Boulevard and Interstate 240 in the south central portion of Memphis.

The Base occupies 85 acres on one parcel of land leased from the Memphis International Airport. The land north and east of the Base is residential. Commercial property lies to the west and south. Immediately east of the Base is the Memphis International Airport. Nonconnah Creek is located approximately 1600 feet north of the Base. Figure 2 shows the current area and boundaries of the Base.

The population of the Base, including Unit Training Assembly (UTA), is approximately 1000 people. There are 222 full time Base personnel during the week. There is no residential property within a 1-mile radius of the Base.

B. History of the Base

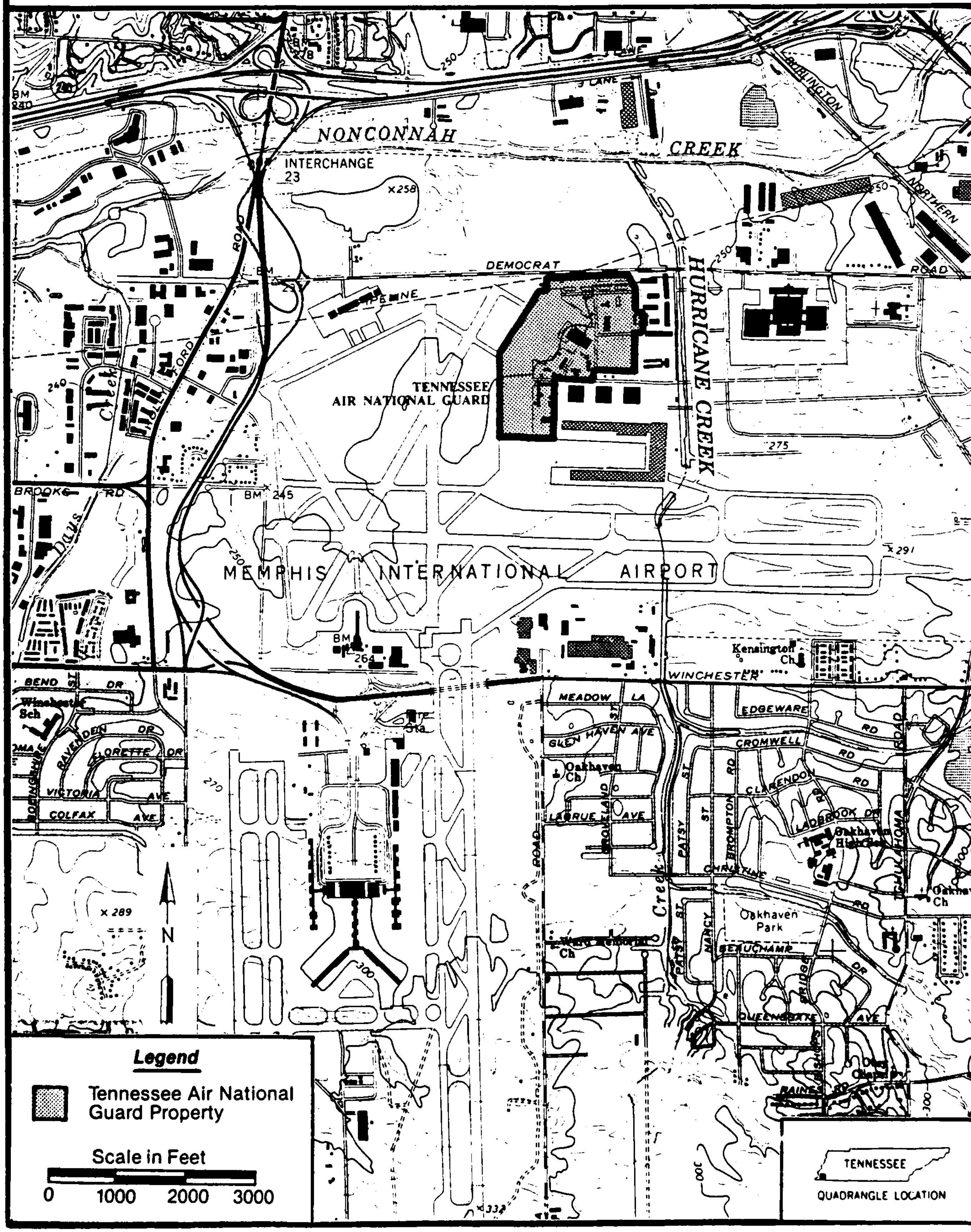
Prior to 1947, the U.S. Government licensed the Department of the Army and Department of the Navy to occupy and use the present Base property. After 1947 the property was occupied by the United States Air Force. During the time-frame 1958-1959, the U.S. Government gave the property to the Memphis-Shelby County Airport Authority. On July 1, 1959, the airport authority leased the property to the Tennessee Air National Guard, (United States of America), which will continue to operate under this lease through the year 2009.

The Base has used numerous types of aircraft throughout its history, including in chronological order the P-51 Fighter, the RB-26 Reconnaissance and Night Bomber, the RF-84 Reconnaissance, the C-97 Cargo, the C-124 Cargo, and presently, the C-130A Cargo.

HMTC

Adapted From: USGS, 7.5 Minute Series Quadrangle, Southeast Memphis, Tenn., 1983.

Figure 2.
Location Map of the 164 TAG, Tennessee Air National Guard, Memphis International Airport, Memphis, Tennessee.



III. ENVIRONMENTAL SETTING

A. Meteorology

The meteorological data presented below is from local climatological data compiled by the National Oceanic and Atmospheric Administration (NOAA) for Memphis, Tennessee.

The climate of the Memphis area is characterized by relatively mild winters, hot summers, and abundant rainfall. Although Memphis is well inland from large bodies of water, it lies in the path of cold air moving down from Canada and warm moist air moving up from the Gulf of Mexico. Consequently, there are extreme and frequent changes in weather from both day to day and season to season. The average summer temperature is 80.9 ^{o}F, and the average winter temperature is 42.3 ^{o}F.

Precipitation is usually well-distributed throughout the year, and therefore, there are no dry seasons. The summer rains usually occur as convective showers. The annual snowfall is 3.9 inches.

Memphis has an average annual precipitation of 49.73 inches based on the period from 1931-1960. Net precipitation is calculated by subtracting the mean annual lake evaporation (40 inches) from the average annual precipitation according to the method outlined in the Federal Register (47 FR 31224, July 16, 1982). Using this formula, a net precipitation value of 9.73 inches per year is obtained. Rainfall intensity, based on 1-year, 24-hour duration rainfall, is 3.2 inches (calculated according to 47 FR 31235, July 16, 1982, Figure 8).

B. Geology

The Base and the City of Memphis are located in the Coastal Plains Physiographic Province. Regionally, the Coastal Plains Province encompasses a portion of the Atlantic coastal states, Gulf coastal states, and the Mississippi River Valley. The Chickasaw Bluffs separate the Memphis area into two Coastal Plain subdivisions; the Gulf Coastal Plain and the Mississippi Alluvial Plain.

The Base is located in the Gulf Coastal Plain (Graham and Parks, 1986).

Surface topography within the Gulf Coastal Plain, which has been modified by stream erosion, varies from steep to gently rolling. Surface elevations range from 190 feet to 470 feet Above Mean Sea Level (AMSL) (Graham and Parks, 1986).

The land surface at the Base is relatively flat. Surface elevations are approximately 250 feet AMSL. Topographic relief at the Base and in its immediate vicinity (one-half mile radius from the Base) ranges from 0 to 25 feet.

Structurally, the Base is located in the northern portion of the Mississippi Embayment, a broad trough or synclinal basin that plunges gently to the south (Stearns, 1975). The axis of this synclinal basin follows the present course of the Mississippi River (Graham and Parks, 1986). Regionally, the Mississippian Embayment encompasses portions of Louisiana, Mississippi, Arkansas, Tennessee, Kentucky, Illinois, and Missouri. Formations that were deposited in the area of the Base dip gently westward toward the axis. These formations crop out updip and east of the Base (Tennessee Division of Geology, 1966).

The subsurface geological units that overly the Paleozoic aged bedrock at the Base and in its immediate vicinity consist of a 3000 foot sequence of relatively unconsolidated sand, gravel, clay, chalk, and lignite. These deposits make up formations belonging to the Cretaceous, Tertiary, and Quaternary Systems. In ascending stratigraphic sequence are the Cretaceous aged Tuscaloosa Formation, Eutaw Formation, Coffee Sand, Sardis Formation, Demopolis Formation, Coon Creek Formation, McNairy Sand, and Owl Creek Formation; the Tertiary aged Old Breastworks Formation, Ft. Pillow Sand, Flour Island Formation, Memphis Sand, Jackson Formation; and the Quaternary aged fluvial deposits, loess, and alluvial deposits. A lithologic description of each of these units is included in Table 1. Geologic maps published by the Tennessee Division of Geology (1966) illustrate that the sediments at the Base, which underlie the surficial soils, are Quaternary aged loess deposits. In the immediate vicinity of the Base, these deposits range in depth from two to thirty feet.

Table 1. Stratigraphic Section at the Base

System	Subdivisions	Thickness	Lithology
Quaternary	Alluvium Deposits	0 - 175 feet	Sand, gravel, silt, clay
	Loess	0 - 65 feet	Silt, silty clay, and minor sand
	Fluvial Depositsl	0-100 feet	Iron-stained gravel, sand, silt, and clay
Tertiary	Jackson Formation	0-360 feet	Clay, silt, sand, and lignite
	Memphis Sand	500 to 890 feet	Sand with minor amounts of clay
	Flour Island Formation	160 to 310 feet	Clay, silt, sand, and lignite
	Fort Pillow Sand	125 to 305 feet	Sand with minor amounts of clay and lignite
	Old Breastworks Formation	180 to 350 feet	Clay, silt, sand, and lignite
Cretaceous	Owl Creek Formation	0 to 40 feet	Sandy clay, greenish-gray, glauconitic, fossiliferous; merges northward into unfossiliferous clays and sands
	McNairy Sand	More than 300 feet	Predominantly sand, in places interbedded with silty light-gray clays. Fine-grained sand at base, locally contains heavy minerals.
	Coon Creek Formation	140 feet	Fossiliferous, micaceous sand, silty and glauconitic; locally fossiliferous sand at base. Siderite common in upper part.
	Demopolis Formation	180 feet	Marl and calcareous clay, light gray, fossiliferous, locally glauconitic and sandy.
	Sardis Formation	70 feet	Quartz sand and glauconitic sand, argillaceous and locally fossiliferous
	Coffee Sand	25 to 200 feet	Loose, fine-grained sand, light gray, sparsely glauconitic, locally interbedded with laminated lignitic clay.
	Eutaw Formation	0 to 180 feet	Grayish-green sand, fine-grained, glauconitic, micaceous; interbedded with gray laminated clays that commonly contain carbonized or silicified wood.
	Tuscaloosa Formation	0 to 140 feet	Poorly sorted, light gray chert gravel in a matrix of silt and sand; locally inter-bedded with sand and clay lenses.

Source: Graham and Parks, 1986; Tennessee Division Geology, 1966.

C. Soils

The surficial soils at the Base and Memphis International Airport are Graded Land (Gr), a soil type that occurs in areas where the natural soil has been disturbed by the construction of subdivisions, buildings, or other features (Figure 3). The depth to which these areas were disturbed ranges from a few inches to 5 feet. Graded Land is a mixture of the Memphis, Loring, and Grenada soil types (SCS, 1970).

Graded Land consists of yellowish-brown, dark brown, acidic, friable silty loam. It's permeability is less than 1 X 10^{-5} cm/sec. The erosion hazard is slight.

Seven soil borings were drilled in the area where the old Fire Department Building once stood. The loess deposits, which underlie the surficial soil to a depth of approximately 27 feet consist of gray and brown silty clay and fine-grained sand. Below this interval to a maximum depth of 40 feet, the material consists of sandy silt and gravelly sand with a trace of silt. Additional information from these soil borings and a soil boring location map are included in Appendix D.

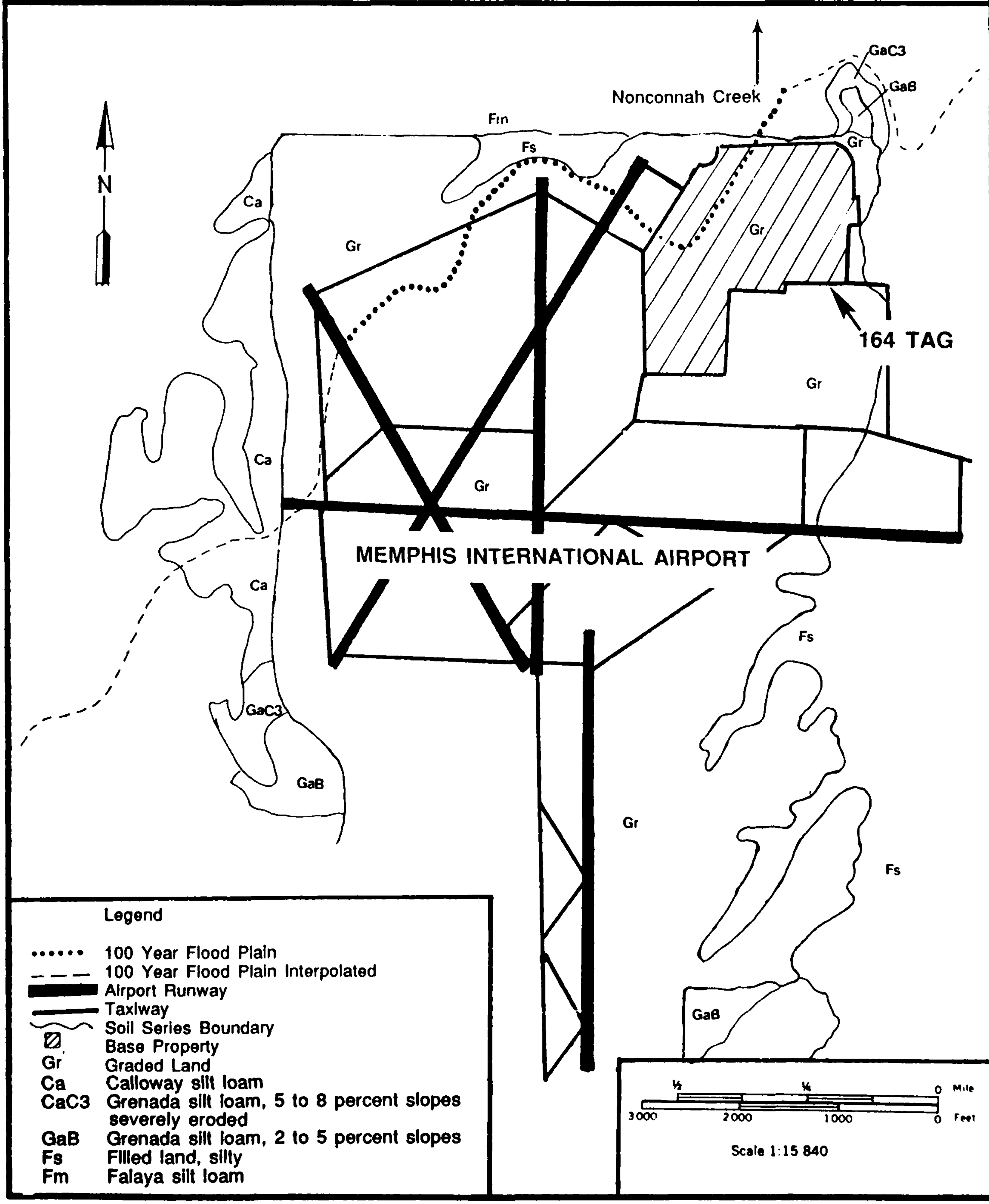
D. Hydrology

1. Surface Water

Surface water at the Base is collected in a series of storm drains, open ditches, and drainage swales. Storm drainage from the southern and eastern half of the Base flows into Hurricane Creek approximately 800 feet from the Base's eastern boundary. Hurricane Creek flows into Nonconnah Creek 1600 feet from the Base's northern boundary. Storm drainage from the northern and western half of the Base outfalls into an unnamed stream which flows into Nonconnah Creek 2500 feet northwest of the Base's northwestern boundary (see Figure 4). The Base does not have a National Pollutant Discharge Elimination System (NPDES) permit. Nonconnah Creek flows into the Mississippi River 5 miles west of the Base. The 100-year flood plain is located at 247.1 feet AMSL. The Nonconnah Creek area, including northern portions of the Base and the airport, are within the boundaries of the 100-year flood plain (Figure 3) (Stearns, 1975). The main portion of the Base lies outside the flood plain at approximately 250 feet AMSL.

HMTC Source: SCS, 1970

Figure 3.
Soil Map of the 164 TAG, Tennessee Air National Guard and Vicinity.



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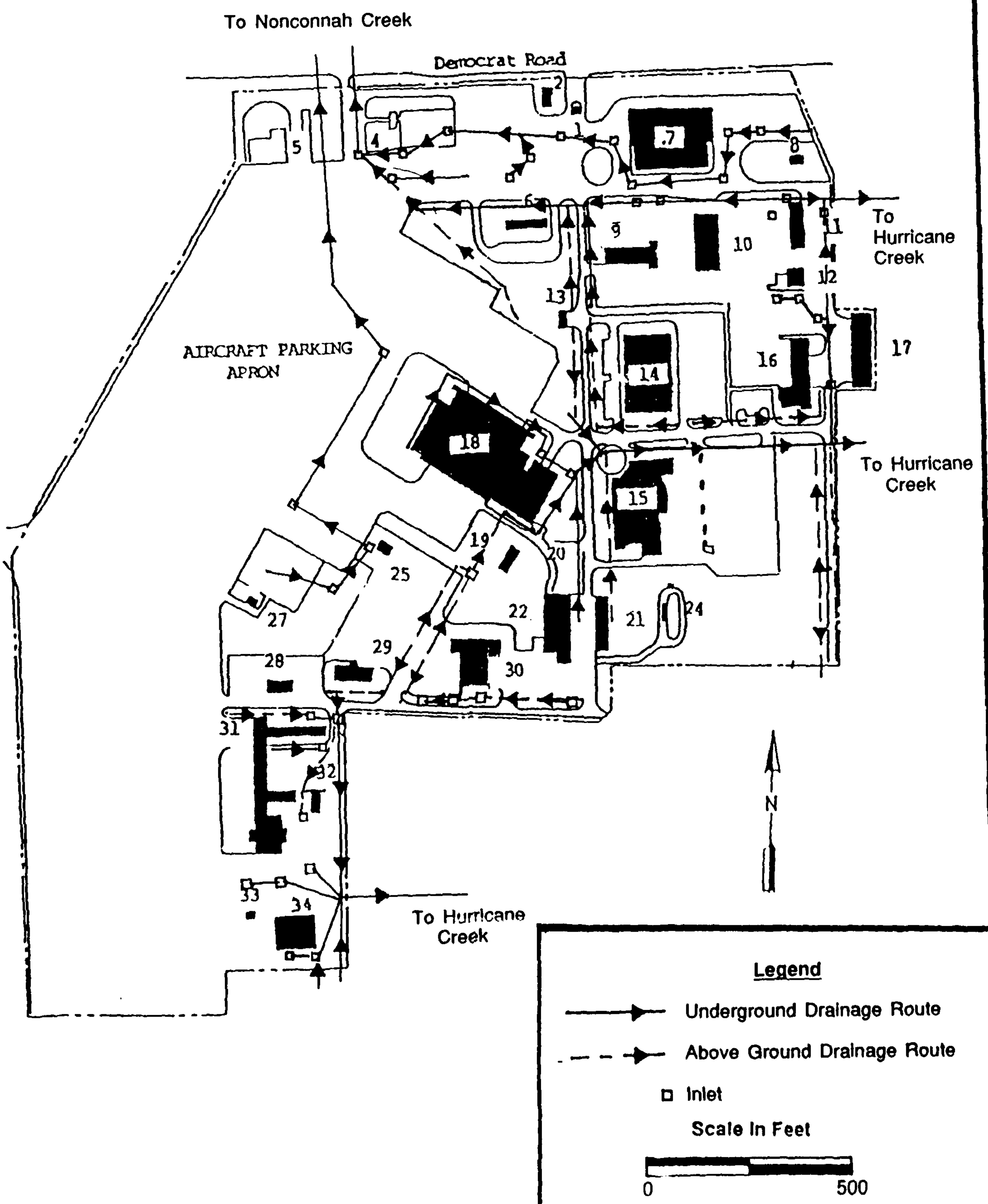
Source: TNANG, Storm Drainage System, 1983.

Figure 4.
Drainage Map, 164th TAG, Tennessee Air National Guard, Memphis International Airport, Memphis, Tennessee.



2. Groundwater

Three groundwater aquifers underlie the Base and the entire Memphis area. These aquifers in descending stratigraphic sequence are the Water Table, Memphis Sand, and Ft. Pillow Sand. The Memphis Sand Aquifer is the primary groundwater supply for the City of Memphis and Shelby County, Tennessee. The Water Table and Ft. Pillow Sand aquifers are considered secondary or backup groundwater supplies.

The Water Table aquifer occurs in Quaternary aged fluvial deposits (Graham and Parks, 1986). Groundwater that occurs in these deposits is produced from permeable sections of sand and gravel with minor amounts of clay. This sand and gravel directly underlies the surficial loess deposits throughout the Gulf Coastal Plain. The thickness of these sand and gravel deposits ranges from 0 to 100 feet (Graham and Parks, 1986). The Water Table aquifer is unconfined and recharged locally by the infiltration of meteoric water (Graham and Parks, 1986).

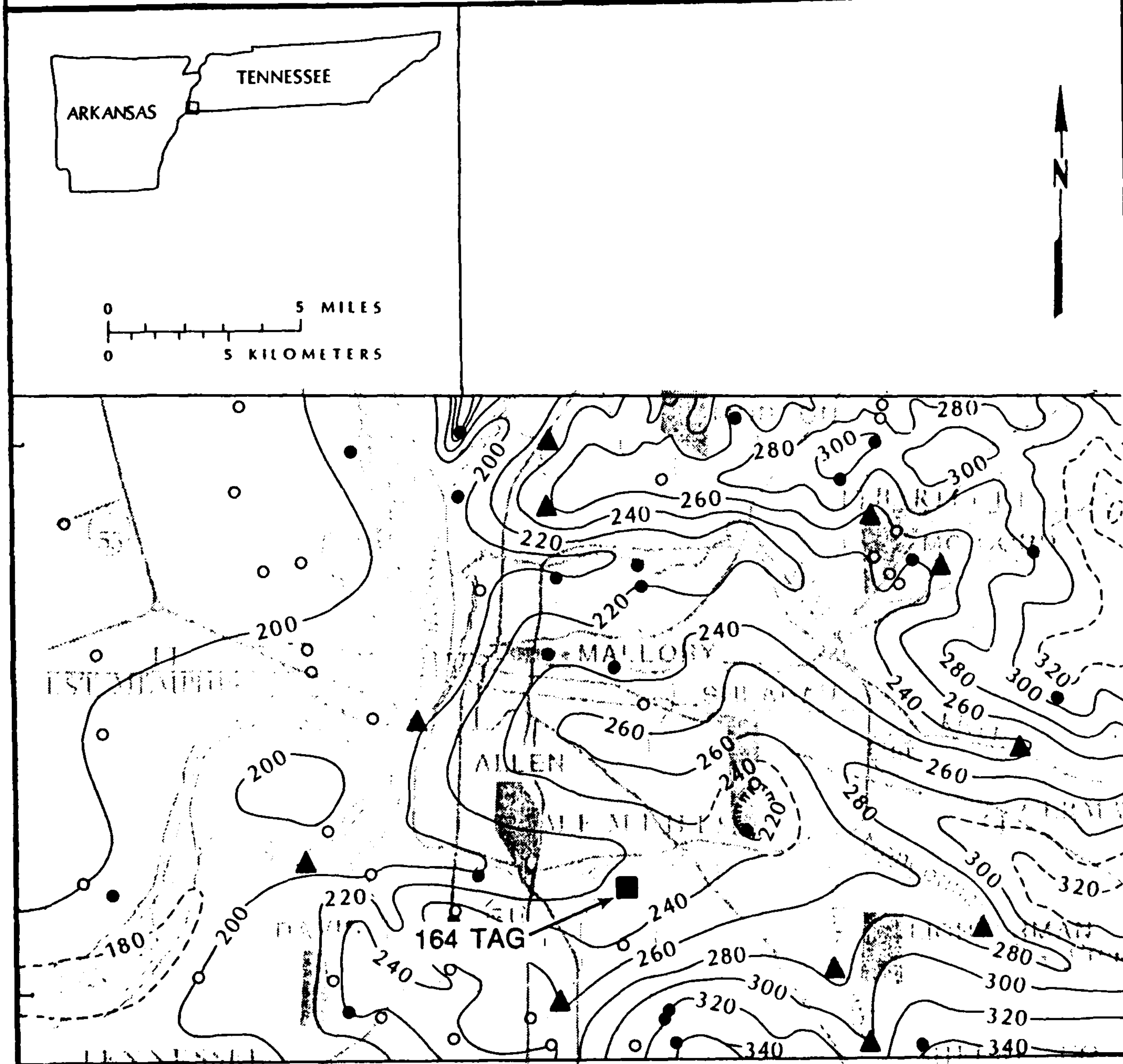
The seasonal high water table at the Base ranges from 4 to 10 feet below the land surface (SCS, 1970). However, soil borings that were drilled at the Base to a maximum depth of 40 feet did not penetrate a significant water saturated interval. Potentiometric contours that map the Water Table aquifer's surface indicate that groundwater from this aquifer at the Base flows to the northwest toward (Figure 5) Nonconnah Creek (Graham and Parks, 1986).

The Memphis Sand aquifer occurs within the Tertiary aged Memphis Sand Formation. Groundwater is produced from permeable, coarse-grained sand that contains clay and silt lenses. These sediments are penetrated at the Base and in the Memphis area at depths ranging from 300 to 500 feet below the land surface. Their thickness ranges from 500 to 890 feet.

The Memphis Sand aquifer is confined. Hydrological communication and recharge from the Water Table aquifer is prohibited by low permeable clays, silts, and fine-grained sands within the overlying Tertiary aged Jackson Formation (Graham and Parks, 1986). The Memphis Sand is recharged updip and east of the Base where the Memphis Sand Formation crops out (Graham, 1982). Water that enters the aquifer at the outcrop moves slowly westward

Source: Graham and Parks, 1986.

Figure 5.
Potentiometric Contours of the Water Table Aquifer.



EXPLANATION

— 320 — WATER-TABLE CONTOUR--Shows altitude of water table. Dashed where inferred. Hachures indicate depression. Contour interval 20 feet. Datum is sea level

● WELL FOR WHICH MEASUREMENT MADE IN FALL 1984 WAS USED AS CONTROL

○ WELL FOR WHICH HISTORIC MEASUREMENT WAS USED AS SUPPLEMEMNTARY CONTROL

▲ GAGE FOR WHICH LOW-STAGE MEASUREMENT MADE IN FALL 1984 WAS USED AS CONTROL

toward the Mississippi Embayment axis (Graham and Parks, 1986). Potentiometric contours that map the Memphis Sand's potentiometric surface illustrate that groundwater at the Base flows to the north toward Nonconnah Creek (Figure 6).

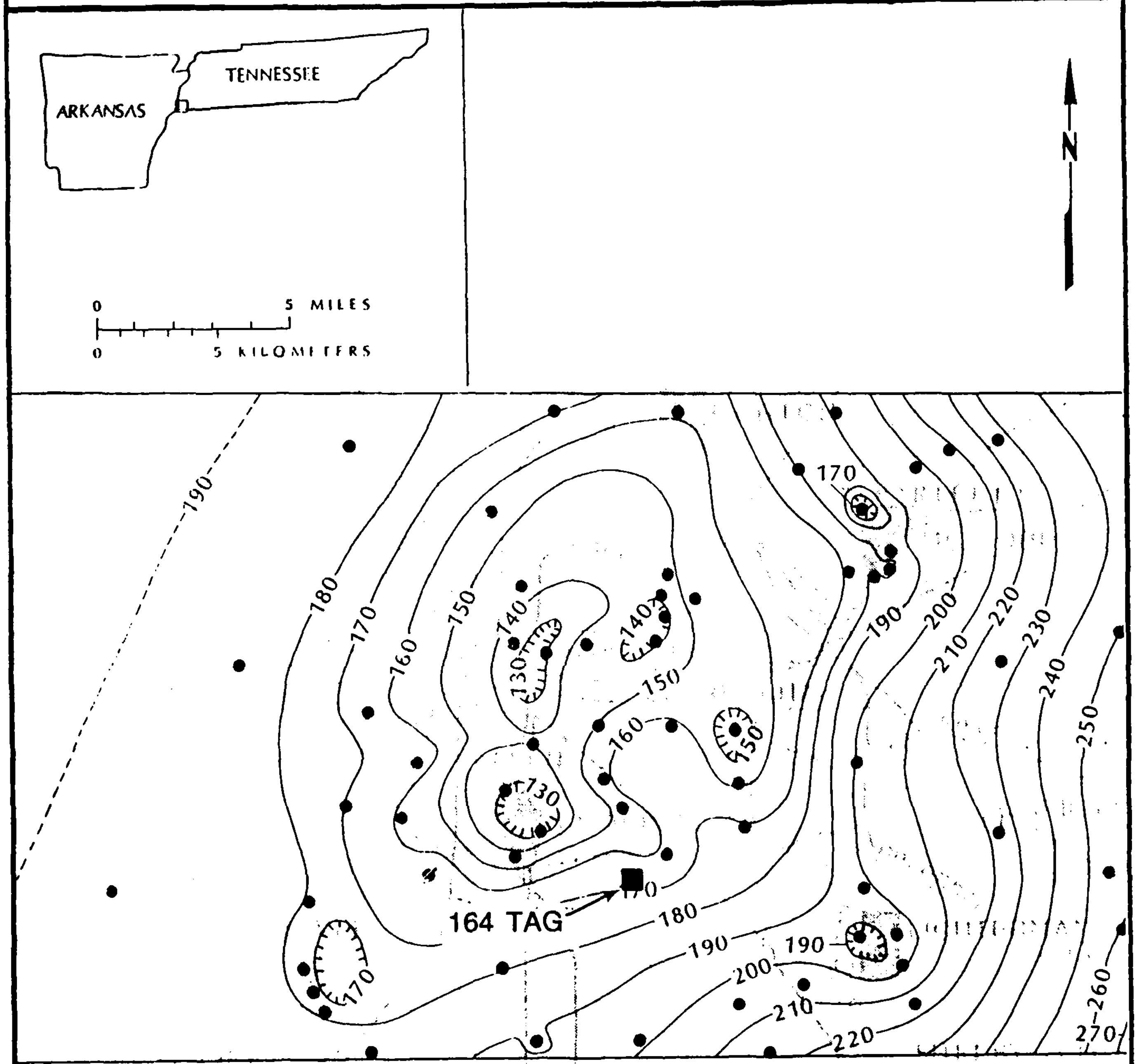
The Ft. Pillow Sand aquifer occurs within the Tertiary aged Ft. Pillow Sand Formation. Groundwater is produced from permeable fine- to medium-grained sands. Their thickness ranges from 125 to 305 feet. They are penetrated at a depth of approximately 1000 feet below the land surface (Graham and Parks, 1986). Like the Memphis Sand, the Ft. Pillow Sand is a confined aquifer. The overlying Flour Island Formation contains confining beds that prevent hydrological communication and recharge from shallower aquifers. The Ft. Pillow Sand (like the previously described Memphis Sand) is recharged updip and east of the Base where the Ft. Pillow Sand Formation crops out (Graham, 1982). Contours that map the Ft. Pillow potentiometric surface indicate that groundwater from this aquifer at the Base flows to the northwest toward the Mississippi River (Figure 7).

The Base and the majority (90 - 95%) of the Memphis area obtains its potable water from the Memphis Light, Gas, and Water Division (MLGW). Throughout the history of the Base (Tennessee Air National Guard Operations, 1959 to present) no water wells have been drilled on Base property. The water well nearest the Base is located approximately one mile east-northeast from the Base's eastern boundary. The well is slightly upgradient from the Base. It is a privately owned well that supplies water for domestic purposes. The MLGW obtains its water from six well fields that contain a total of 110 wells. These fields are spaced at six mile intervals throughout Shelby County, Tennessee. Correspondence with the MLGW indicated that no municipal wells are located within a 4 mile radius of the Base. Also, the MLGW indicated that the Water Table aquifer is not used as a potable water source within the immediate vicinity of the Base or in the entire Memphis area. Each of the MLGW's municipal wells taps the Memphis Sand. Their yield averages approximately 1000 GPM.

The MLGW has collected groundwater samples from five pumping stations throughout Shelby County, Tennessee. These samples were analyzed for naturally occurring constituents and water quality. The results of these analyses are included in Table 2. According to the MLGW,

HMTC Source: Graham and Parks, 1986.

Figure 6.
Potentiometric Contours of the Memphis Sand Aquifer.



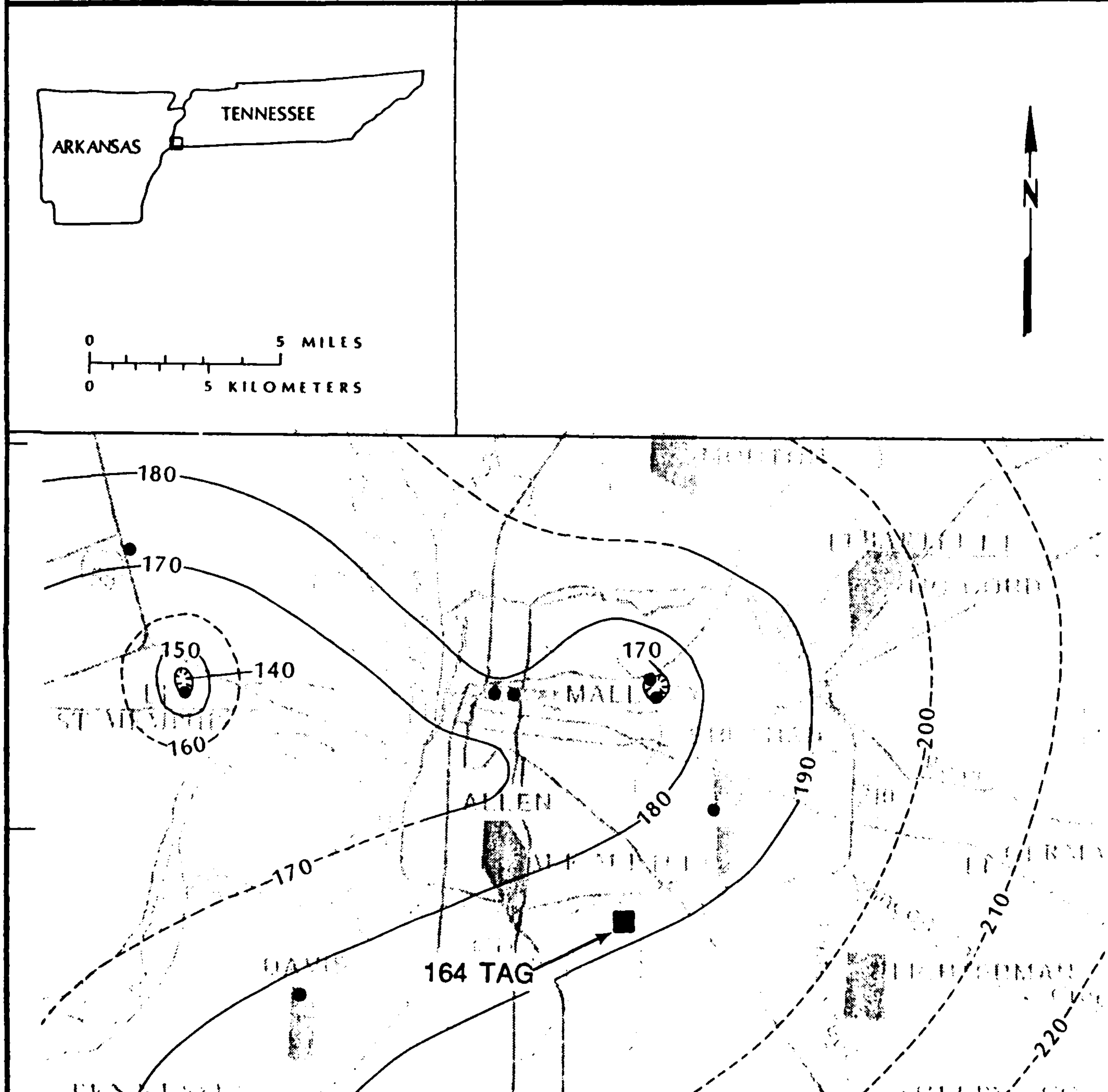
EXPLANATION

190 POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Hachures indicate depression. Contour interval 10 feet. Datum is sea level

● OBSERVATION WELL

HMTC Source: Graham and Parks, 1986.

Figure 7.
Potentiometric Contours of the
Ft. Pillow Sand Aquifer.



EXPLANATION

190 POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells. Dashed where inferred. Hachures indicate depression. Contour interval 10 feet. Datum is sea level

● OBSERVATION WELL

Table 2. Analyses of Water Supplied by the Memphis Light, Gas, and Water Division*

	Sheahan Station	Allen Station	McCord Station	Mallory Station	Lichterman Station
Before Aeration					
Iron (Fe)	0.61	0.48	0.73	0.70	0.028
Manganese (Mn)	0.022	0.018	0.017	0.012	0.009
Fluoride (F)	0.09	0.09	0.08	0.09	0.08
pH	6.6	6.4	6.4	6.4	6.3
After Aeration, Filtration, and Fluoridation					
Iron (Fe)	0.020	0.020	0.070	0.030	0.020
Manganese (Mn)	0.001	0.001	0.005	0.006	0.016
Fluoride (F)	0.99	1.01	0.98	1.02	0.98
pH	7.1	7.1	7.2	7.2	7.2
Alkalinity ($CaCO_3$)	40.0	66.0	48.0	60.0	38.0
Hardness ($CaCO_3$)	36.0	66.0	46.0	54.0	32.0
Calcium ($CaCO_3$)	22.0	44.0	28.0	36.0	22.0
Magnesium ($CaCO_3$)	14.0	22.0	18.0	18.0	10.0
Sodium (Na)	8.2	9.2	8.8	8.8	7.6
Potassium (K)	0.78	1.01	0.91	0.86	0.56
Sulfate (SO_4)	14.4	17.2	3.3	5.1	19.3
Chloride (Cl)	3.6	5.2	7.1	4.1	5.9
Nitrate (NO_3)	0.12	0.10	0.11	0.09	0.70
Phosphate (PO_3)	1.5	1.4	1.5	1.6	1.4
Dissolved Solids	56.0	116.0	92.0	80.0	60.0
Silica (SiO_2)	14.5	16.0	13.0	15.0	14.0
Temperature at Station (^{o}F)	65.0	63.0	63.0	65.0	63.0

Note: pH is influenced by aeration efficiency which varies slightly with the pumping rate and wind velocity.

* Chemical constituents are measured in mg/l = parts per million.

the Memphis International Airport and the Base are served by the Allen and McCord Stations.

Prior to 1975, the Fort Pillow Sand aquifer was tapped as a potable water source (Criner and Parks, 1976). Although the MLGW presently obtains all its potable water from the Memphis Sand, their future plans include the drilling of Ft. Pillow test wells. Presently, the MLGW classifies the Ft. Pillow Sand aquifer as a backup groundwater supply. According to the MLGW, Ft. Pillow wells frequently yield in excess of 2000 GPM.

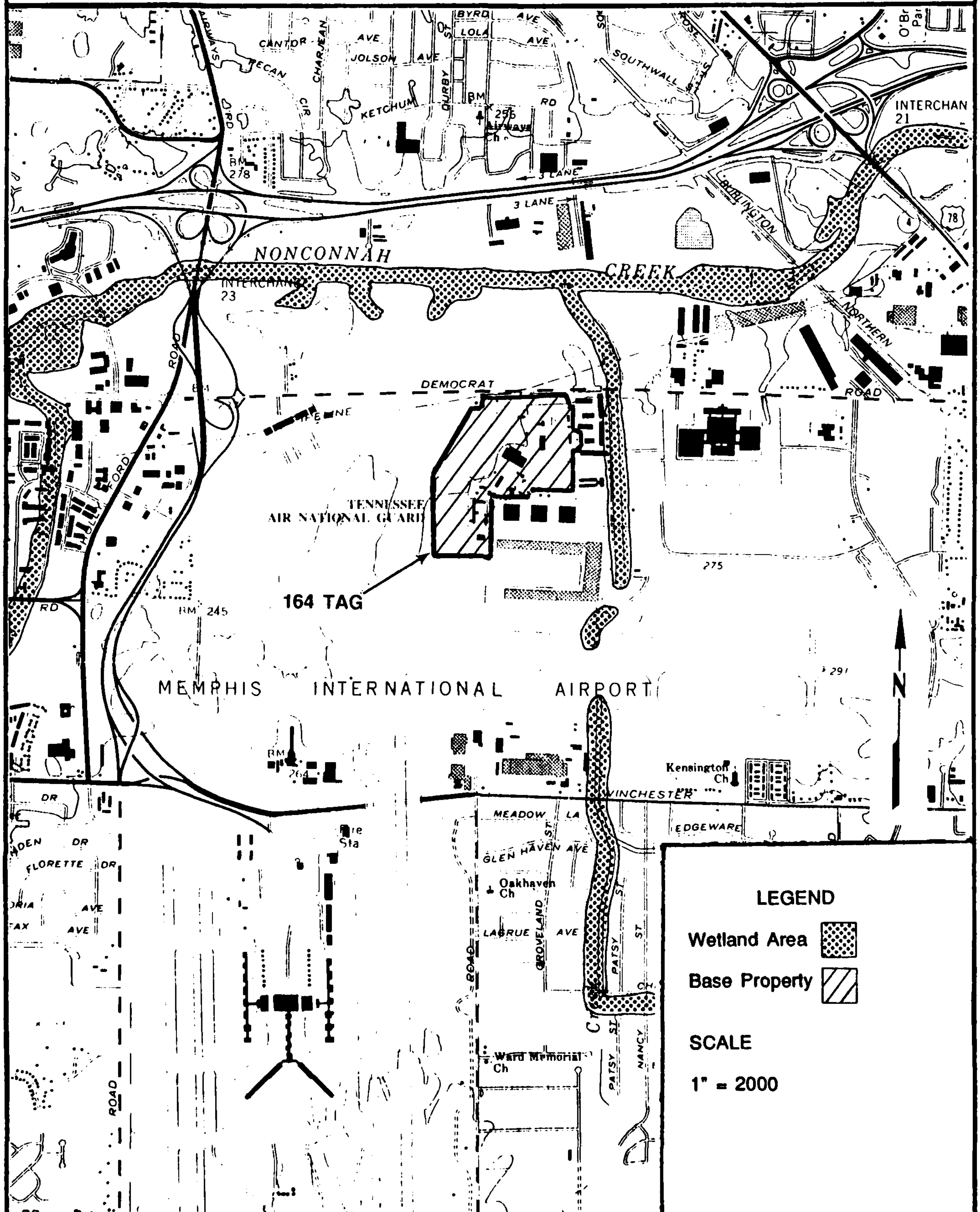
E. Critical Environments

According to the Tennessee Wildlife Resources Agency (Hatcher, 1988), there are no endangered or threatened species of flora or fauna within a 1-mile radius of the Base. Furthermore, there are no wilderness areas within a 1-mile radius of the Base. Minor wetlands are located along Nonconnah Creek and Hurricane Creek at points within a 1-mile radius of the Base (Figure 8).

HMTC

Source: U.S. Fish and Wildlife Service, 1987.

Figure 8.
Wetland Areas in the Vicinity of the Base.



IV. SITE EVALUATION

A. Activity Review

A review of Base records and interviews with past and present Base personnel resulted in the identification of specific operations at the Base in which the majority of industrial chemicals are handled and hazardous wastes are generated. A total of 16 past and present Base personnel with an average of 17 years of Base experience were interviewed. These personnel were representative of Aircraft Maintenance, Non-Destructive Inspection, the Energy Plant, Air Conditioning/Refrigeration, Vehicle Maintenance, Aerospace Ground Equipment Maintenance, Fuels Management, Entomology, and the Photographic Laboratory.

Table 3 summarizes these major operations, provides estimates of the quantities of waste currently being generated by these operations, and describes the past and present disposal methods for the wastes. Table 3 begins in 1959 when the Tennessee Air National Guard acquired the property by lease from the Memphis-Shelby County Airport Authority. Any operation that is not listed in Table 3 has been determined to produce negligible quantities of wastes requiring disposal.

B. Disposal/Spill Site Identification, Evaluation, and Hazard Assessment

Interviews with Base personnel and subsequent facility inspections did not result in the identification of sites potentially contaminated with HM/HW. The Base's buildings and facilities are listed on Table 4, and their locations are shown on Figure 9.

Although no sites were identified and assigned a HAS according to HARM, the methodology and guidelines are included as Appendix C. The objective of this assessment is to provide a relative ranking of sites suspected of contamination by hazardous substances. The final rating score reflects specific components of the hazard posed by a specific site: possible receptors of the contamination (e.g., population within a specified distance of the site and/or critical environments within a 1-mile radius of the site); the waste and its characteristics; and the

Table 3. Hazardous Materials/Hazardous Wastes Disposal Summary: 164th TAG, Tennessee Air National Guard, Memphis, Tennessee

Shop Name and Location	Hazardous Wastes/ Used Hazardous Materials	Estimated Quantities (Gallons/Year)	Method of Treatment/Storage/Disposal 1959 1970 1980 1989
Aircraft Maintenance (Bldg. 358)	PD-680 Solvent	200	NIU | DRMO
	Trichloroethane	2	EVAP/SAN | NLU
	Battery Acid	12	NSAN
	Carbon Cleaner	10	SAN | DRMO
	Strippers (MEK, MIBK)	200	SAN | NLU
	Synthetic Turbine Oil	500	NIU | DRMO
	JP-4	200	NIU | DRMO/FTA
	Xylene	2	SAN | NLU
	7808 Oil	100	SAN | DRMO | NLU
	Hydraulic Oil	500	FTA | DRMO
	Engine Oil	1000	FTA | NLU
	AVGAS	500	FTA | NLU
	Varsol	100	FTA | NLU
	MEK	50	NIU | EVAP/DRMO

KEY:

CONTR - Disposed of through a Hazardous Waste Contractor.
DRMO - Disposed of through the Defense Reutilization & Marketing Office. (Prior to 1986, this office was known as the Defense Property Disposal Office (DPDO).)
EVAP - Evaporated during use.
FTA - Disposed of at a Fire Training Area, an off-Base, joint-use facility.
LNDFL - Landfilled off-Base at a Memphis area landfill.
NIE - Shop not in existence.
NIU - Material not in use.
NLU - Material no longer used.
NSAN - Material neutralized and disposed of through the sanitary sewer system.
SAN - Disposed of through the sanitary sewer.
SR - Sent to Eaker Air Force Base for recovery of silver.

Table 3. Hazardous Materials/Hazardous Wastes Disposal Summary: 164th TAG, Tennessee Air National Guard, Memphis, Tennessee (continued)

Shop Name and Location	Hazardous Wastes/ Used Hazardous Materials	Estimated Quantities (Gallons/Year)	Method of Treatment/Storage/Disposal 1959 1970 1980 1989
Fuels Management (Bldg. 22)	JP-4	440	NIU | FTA
	Tank Cleaning Sludge	200	FTA
	AVGAS	230	FTA | NLU
Entomology (Bldg. 490)	Pesticides	1	LNDFL
	Empty Pesticide Containers	4	LNDFL
Photographic Laboratory (Bldg. 454)	Developer	30	SAN
	Fixer (silver)	10	NEUT/DRMO | SR
Non-Destructive Inspection (NDI) (Bldg. 368)	MEK	5	NIE | EVAP
	Developer (silver)	5	NIE | SAN/SR | SR
	Fixer (silver)	5	NIE | SAN/SR | SR
	PD-680	5	NIE | DRMO

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Table 3. Hazardous Materials/Hazardous Wastes Disposal Summary: 164th TAG, Tennessee Air National Guard, Memphis, Tennessee (continued)

<table>
<tr><th rowspan="2">Shop Name and Location</th><th rowspan="2">Hazardous Wastes/ Used Hazardous Materials</th><th rowspan="2">Estimated Quantities (Gallons/Year)</th><th colspan="3">Method of Treatment/Storage/Disposal</th></tr>
<tr><th>1959</th><th>1970</th><th>1980 1989</th></tr>
<tr><td rowspan="5">Aerospace Ground Equipment (AGE) Maintenance (Bldg 450)</td><td>Engine Oil</td><td>55</td><td colspan="2">FTA</td><td>DRMO</td></tr>
<tr><td>Hydraulic Oil</td><td>5</td><td colspan="2">FTA</td><td>DRMO</td></tr>
<tr><td>7808 Oil</td><td>5</td><td>NIU</td><td>FTA</td><td>DRMO</td></tr>
<tr><td>PD-680</td><td>1</td><td>NIU</td><td>FTA</td><td>DRMO</td></tr>
<tr><td>Turbine Oil</td><td>1</td><td colspan="2">NIU</td><td>DRMO</td></tr>
<tr><td rowspan="8">Vehicle Maintenance (Bldg. 452)</td><td>JP-4</td><td>600</td><td>NIU</td><td colspan="2">FTA</td></tr>
<tr><td>Engine Oil</td><td>500</td><td colspan="3">CONTR</td></tr>
<tr><td>Ethylene Glycol</td><td>300</td><td colspan="3">CONTR</td></tr>
<tr><td>Paint Thinner</td><td>15</td><td colspan="3">DRMO</td></tr>
<tr><td>Lubricating Oil</td><td>5</td><td colspan="3">CONTR</td></tr>
<tr><td>Hydraulic Oil</td><td>5</td><td colspan="3">CONTR</td></tr>
<tr><td>Diesel Fuel</td><td>5</td><td colspan="3">CONTR</td></tr>
<tr><td>Brake Fluid</td><td>1</td><td colspan="3">CONTR</td></tr>
</table>

KEY:

CONTR - Disposed of through a Hazardous Waste Contractor.
DRMO - Disposed of through the Defense Reutilization & Marketing Office. (Prior to 1986, this office was known as the Defense Property Disposal Office (DPDO).)
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SR - Sent to Eaker Air Force Base for recovery of silver.

Table 4. Building and Facility Designations for the Base

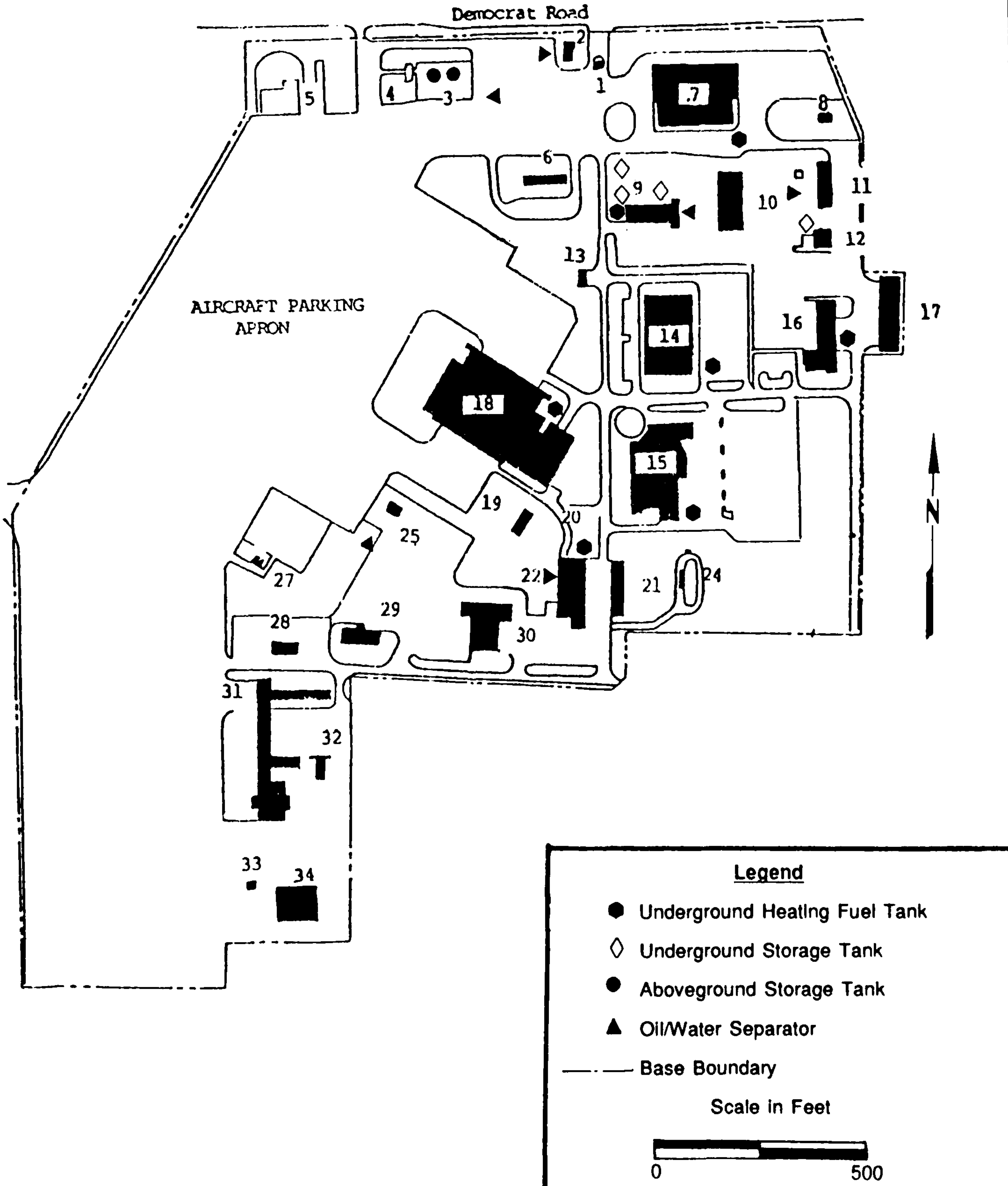
Locator Number*	Building/Facility Name	Building/Facility Number
1.	Main Gate	482
2.	POL Operations Building	472
3.	Jet Fuel Storage	22
4.	POL Pump House	473
5.	Jet Engine Test Stand	5002
6.	Chapel	462
7.	Base Supply	490
8.	Paint Storage Shed	481
9.	Motor Pool	452
10.	AGE Shop	450
11.	Hobby Shop	434
12.	BX and Sub-Motor Pool	436
13.	Paint, Oxygen, and Dope Storage	454
14.	Group Administration	400
15.	Composite Squadron Operations	401
16.	Civil Engineering	440
17.	Base Cafeteria/ANG Club	406
18.	Hangar	358
	- Aircraft Maintenance	
	- Clinic	
	- Dining Hall	
19.	Deluge Pump House	366
20.	Deluge Storage Tank	24
21.	Mobility Storage	367
22.	Engine/NDI Shop	368
23.	Panel Board Building	352
24.	Segregated Magazine	380
25.	Flight Line Building	356
26.	Washrack	31
27.	Washrack Utilities Control Center Bldg.	344
28.	AGE Storage	340
29.	Mobilization	346
30.	Flight Simulator/Disaster Preparedness	370
31.	Fire Station	325
32.	CAMS Mobility Storage	326
33.	Flare Storage Building	317
34.	Aerial Port	315

* Locator numbers are referenced to Figure 8, page IV-7.

HMTC

Source: TNANG Base Map, Undated.

Figure 9.
Base Map, 164 TAG, Tennessee Air National Guard, Memphis International Airport, Memphis, Tennessee.



potential pathways for contaminant migration (e.g., surface water, groundwater, flooding). If the evaluation indicates that the site presents little or no apparent environmental or health hazard, no further IRP action will be scheduled. However, if any IRP sites are identified in the future then IRP actions could be scheduled.

C. Other Pertinent Information

The Base has two aboveground tanks that were constructed in 1983 at the POL area. The fuel pump station, located at the POL area, was constructed in 1960. The POL facility is located within a fenced area and is encompassed by an earth dike with a reinforced concrete surface. Each of the two aboveground tanks have 105,000-gallon capacities and are used to store JP-4 fuel to service jet aircraft at the Base. The tanks are properly vented, have a floating top with a seal, and have a sight gauge that indicates the level of fuel in the tank.

The Motor Pool has a total of three underground tanks. Two of the tanks are for MOGAS and one tank is for diesel fuel. These tanks were inspected in 1979, and no leaks were detected. During the site visit, no visual evidence of leaks was detected.

Building 12 (the old service station) has an 8000-gallon underground tank that was filled with sand and abandoned in place in 1980. An inventory of regulated USTs is included as Appendix E. Tank locations are shown on Figure 9.

The Base has seven backup underground heating oil tanks containing No. 2 fuel oil. They are located as follows: Hangar (Building 358), 12,000 gallons; Civil Engineering (Building 440), 1000 gallons; Base Supply (Building 490), 3000 gallons; Motor Pool (Building 452), 4000 gallons; Group Administration (Building 400), 4000 gallons; Composite Squadron Operations (Building 401), 500 gallons; and Engine/NDI Shop (Building 368), 2000 gallons.

Six oil/water separators (OWSs) were installed at the Base to catch and separate oils from water to prevent the oils from entering the sanitary sewer system.

No tanks on Base have ever been tested for leaks. However, information gathered during the site survey indicates there has never been a leak from any tanks. Also, there have been no significant spills on Base. Figure 9 shows the location of all tanks and oil/water separators.

The Base is currently hooked to the City of Memphis' sanitary sewer system. Connection of facilities on Base property to the sanitary sewer system began about 1948 when the U.S. Air Force occupied the Base's current lease holdings. Waste that passes through the sanitary sewer system is treated at the Maxson Treatment Center, and the treated wastewater is discharged into the Mississippi River.

All of the water used at the Base is municipal water supplied by Memphis Light, Gas, and Water. There are no active or abandoned water wells on the Base.

There are no landfills on the Base.

The Air National Guard has conducted fire training exercises at an off-site, joint-use facility.

V. CONCLUSIONS

Based on information obtained by interviewing past and present Base personnel, reviewing Base records, and making field observations, it was concluded that the Base has no potential sites contaminated by HM/HW.

VI. RECOMMENDATIONS

Further IRP action is not recommended since it has been concluded that the Base has no potential sites contaminated by HM/HW.

GLOSSARY OF TERMS

ALLUVIAL PLAIN - Flood plains produced by the filling of a valley bottom with fine mud, sand, and/or gravel.

AQUIFER - A geologic formation, or group of formations, that contains sufficient saturated permeable material to conduct groundwater and to yield economically significant quantities of groundwater to wells and springs.

CALCAREOUS - A substance that contains calcium carbonate. When used to describe a rock, it implies that as much as 50% of the rock is calcium carbonate.

CLAY [soil] - A rock or mineral particle in the soil having a diameter less than 0.002 mm (2 microns).

CLAY [geol.] - A rock or mineral fragment or a detrital particle of any composition smaller than a fine silt grain and having a diameter less than 1/256 mm (4 microns).

CONTAMINANT - As defined by Section 101(f)(33) of Superfund Amendments and Reauthorization Act of 1986 (SARA) shall include, but not be limited to any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction), or physical deformation in such organisms or their offspring; except that the term "contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under:

(a) any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act,

(b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,

(c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress),

(d) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act,

(e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and

(f) any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to Section 7 of the Toxic Substances Control Act;

and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

CRETACEOUS - The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era); it covered the time span between 135 and 65 million years ago.

CRITICAL HABITAT - The specific areas within the geographical area occupied by the species, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection.

ENDANGERED SPECIES - Any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection would present an overwhelming and overriding risk to man.

FERRUGINOUS SANDSTONE - A sandstone that is cemented with iron oxide.

HARM - Hazard Assessment Rating Methodology - A system adopted and used by the United States Air Force to develop and maintain a priority listing of potentially contaminated sites on installations and facilities for remedial action based on potential hazard to public health and welfare and environmental impacts. (Reference: DEQPPM 81-5, December 11, 1981.

HAS - Hazard Assessment Score - The score developed by utilizing the Hazardous Assessment Rating Methodology (HARM).

HAZARDOUS MATERIAL - Any substance or mixture of substances having properties capable of producing adverse effects on the health and safety of the human being. Specific regulatory definitions are also found in OSHA and DOT rules.

HAZARDOUS WASTE - A solid or liquid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

a. cause, or significantly contribute to, an increase in mortality or an increase in serious or incapacitating reversible illness, or

b. pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

LIGNITE - A brownish-black coal that is intermediate in coalification between peat and subbituminous coal.

MIGRATION (Contaminant) - The movement of contaminants through pathways (groundwater, surface water, soil, and air).

Mississippi Embayment - A broad trough or synclinal basin that plunges gently to the south. Regionally, the Mississippian Embayment encompasses portions of Louisiana, Mississippi, Arkansas, Tennessee, Kentucky, Illinois, and Missouri.

NET PRECIPITATION - Precipitation minus evaporation.

PALEOZOIC - An era of geologic time from the end of the Precambrian to the end of the Mesozoic or from about 570 to 225 million years ago.

PD-680 - A cleaning solvent composed predominately of mineral spirits; Stoddard solvent.

PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

PHYSIOGRAPHIC SUBDIVISION - A region of similar structure and climate that has a unified geomorphic history.

QUATERNARY - The second period of the Cenozoic era, following the Tertiary; also, the corresponding system of rocks. It began two to three million years ago and extends to the present.

SANDSTONE - A medium-grained, fragmented sedimentary rock composed of abundant round or angular fragments of sand, size-set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate).

SHALE - A fine-grained detrital sedimentary rock formed by the consolidation (especially by compression) of clay, silt, or mud.

SURFACE WATER - All water exposed at the ground surface, including streams, rivers, ponds, and lakes.

SYNCLINE - A fold of which the core contains the stratigraphically younger rocks; it is generally concave upward.

TERTIARY - The first period of the Cenozoic era (after the Cretaceous of the Mesozoic era and before the Quaternary); it spanned the time between 65 and three to two million years ago.

THREATENED SPECIES - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TOPOGRAPHY - The general conformation of a land surface, including its relief and the position of its natural and man-made features.

WATER TABLE - The upper limit of the portion of the ground that is wholly saturated with water.

WETLANDS - An area subject to permanent or prolonged inundation or saturation by water and that exhibits plant communities adapted to this environment.

WILDERNESS AREA - An area unaffected by anthropogenic activities and deemed worthy of special attention to maintain its natural condition.

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Appendix A

Resumes of Search Team Members

JEFFREY D. FLETCHER

EDUCATION

B.S., geology, Millersville University, 1984

EXPERIENCE

Technical and field experience includes geologic mapping, water well site location, and construction of water table maps. Expertise in hazardous waste management including site evaluations and preparation of records searches for the Phase I portion of the Installation Restoration Program for the Air Force and the Phase II Preliminary Assessment of the Hazardous Waste Site Investigation Program for the Federal Bureau of Prisons. Experience also includes principal investigator in charge of a Hazardous Waste Survey/ Historical Records Search for the U.S. Coast Guard.

EMPLOYMENT

Dynamac Corporation (1986-present): Staff Scientist/Geologist

Responsibilities include site evaluations and preparation of records searches for Phase I of the Installation Restoration Program for the Air National Guard and Phase II - Preliminary Assessments of the Hazardous Waste Site Investigation Program for the Federal Bureau of Prisons. Efforts include assessment of hazardous waste disposal/spill sites for the purpose of determining rates and extents of contaminant migration and for identifying remedial actions.

Fletcher-Lowright and Assoc., Consulting Geologists (1984-1985): Geohydrology Assistant

Primary duties included site location of water wells, analysis of well yield data through the use of computers, and construction of water table maps.

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Phase II - Preliminary Assessment for the Englewood Federal Correctional Institution at Englewood, Colorado. June 1987.

Phase II - Preliminary Assessment for the Atlanta Federal Penitentiary at Atlanta, Georgia. May 1987.

Phase II - Preliminary Assessment for the Ashland Federal Correctional Institution at Ashland, Kentucky. June 1987.

Phase II - Preliminary Assessment for the Sandstone Federal Correctional Institution at Sandstone, Minnesota. July 1987.

KATHRYN A. GLADDEN

EDUCATION

B.S., chemical engineering (minor in biological sciences), University of Washington, 1978

SECURITY CLEARANCE

Secret DOD clearance

EXPERIENCE

Seven years of experience in hazardous waste consulting and plant process engineering. Experience includes development of engineering alternatives for reduction of in-plant effluents and preparation of RCRA background listing documents for the plastics industry.

EMPLOYMENT

Dynamac Corporation (1985-present): Staff Engineer

Performs studies on the feasibility of solvent recycling, including the evaluation of several alternatives. Studies to date have included 15 sites. For each site, prepared reports describing present practice for solvent use and disposal, and conducted economic analyses of options.

Conducted preliminary site investigations and ranking of hazardous waste sites for the U.S. Federal Bureau of Prisons. Prepared reports detailing site investigation findings and recommendations for Phase II monitoring and sampling.

Preparing statement of work for a Phase IV-A remedial action plan for the Air Force's Installation Restoration Program.

Conducted analysis of public comments on Advanced Notice of Public Rulemaking to establish National Primary Drinking Water Regulations for radionuclide contaminants.

Peer Consultants (1984-1985): Staff Engineer

Developed background documents for listing of RCRA hazardous wastes.

Engineering Science (1983-1984): Staff Engineer

Conducted regulatory policy review and technology assessment of transportation and decontamination procedures for acutely hazardous wastes. Project engineer for development of a cost analysis methodology for the U.S. Army Toxic and Hazardous Materials Agency Installation Restoration Program.

Weyerhaeuser Company (1978-1983): Chemical Engineer

Conducted plant environmental audits to develop in-plant effluent load balances; developed capital alternatives and improved operating procedures for in-plant effluent reduction; developed and implemented recommendations for plant energy conservation and process optimization programs; investigated industrial hygiene impacts of wood pyrolysis air emissions, and performed pilot trials for wood gasification and pyrolysis technology development.

PROFESSIONAL AFFILIATIONS

Tau Beta Pi Engineering Honorary
Society of Women Engineers

ANDY J. PETERS, JR.

EDUCATION

B.S., chemistry, Tulane University, 1977
EPA course: Personnel Protection and Safety
U.S. Army courses: Technical Escort course, Nuclear Emergency Team Operations course

EXPERIENCE

Seven years' experience in hazardous material and waste management. Most recent experience in solving hazardous material and waste management problems for Department of Defense agencies. Six years of military experience in supervising, directing, managing, and planning the transportation, storage, and disposal of chemical and conventional ammunition, explosives, and hazardous material and waste. Knowledgeable of federal DOT and OSHA regulations on hazardous material. Familiar with federal environmental regulations.

EMPLOYMENT

Dynamac Corporation (1985-present): Staff Scientist

Responsibilities within the Hazardous Materials Operation Department. Performs audits on hazardous material and waste operations. Plans and prepares technical reports concerning personal protection, health and safety, transportation, storage, and disposal of hazardous materials and wastes. Prepares and reviews technical proposals dealing with these areas of expertise. Prepares statements of work as part of the U.S. Air Force Installation Restoration Program.

Conducted a study for the Department of Defense concerned with improving military response to accidents involving DOD shipments of explosives, munitions, and hazardous material. Assisted in the preparation of the final drafts of DOD Instruction 4145.19 and DLA Manual 4145.11 governing the storage and handling of hazardous material. Prepared statements of work for Phase IV-A Remedial Action Plans for Minneapolis-St. Paul Air Force Reserve Base and Delaware Air National Guard Base.

U.S. Army Technical Escort Unit (1984-1985): Special Assistant to the Commander

Supervised 21 personnel in the demilitarization of leaking chemical munitions utilizing a mobile demilitarization system. Directed daily operations. Supervised health and safety activities to include personnel and equipment decontamination, adherence to operating procedures, and operation of protective systems and equipment. Directed and supervised system maintenance and supply. Planned monthly work schedules. Supervised all aspects of personnel assignment, training, and administration.

U.S. Army Technical Escort Unit (1983-1984): Operations Officer

Supervised the U.S. and overseas movement of all Department of Defense military chemical agents. Managed and directed the demilitarization or emergency disposal of leaking chemical munitions and material. Deployed and maintained the readiness of the DOD emergency response team tasked to respond worldwide to a military chemical accident. Planned unit mobilization for the deployment of chemical munitions.

U.S. Army Technical Escort Unit (1982-1983): Intelligence Officer

Monitored and supervised all aspects of unit safety, security, and chemical surety. Supervised the storage and transportation of unit ammunition and explosives. Monitored the U.S. and overseas movement of all DOD military chemical agents. Supervised the maintenance of unit radiation records and detection equipment. Developed a unit respiratory protection program. Supervised preparation for all unit safety, security, and surety inspections.

U.S. Army Technical Escort Unit (1980-1982): Chief, Escort and Disposal Team

Supervised the transportation and emergency disposal of military chemical agents, munitions, and other hazardous materials. Planned and supervised the relocation of war reserve stocks of Navy Chemical munitions to include training, logistical management, communications, security, and public relations. Responsible for the welfare, training, and supervision of 30 personnel.

U.S. Army Field Artillery Training Center (1979-1980): Ammunition Officer

Supervised, directed, and managed the pickup, delivery, and return of small arms and artillery ammunition, pyrotechnics and explosives. Developed and implemented a vehicle maintenance program, an ammunition accounting system, and a safety awareness program. Responsible for the welfare, training, and supervision of 30 personnel.

GRACE E. HILL

EDUCATION

B.S. (enrolled), Environmental Science, University of the District of Columbia
A.S., Marine Science, University of the District of Columbia, 1984

CERTIFICATION

Health & Safety Training Level C

EXPERIENCE

Seven years of experience in various environmental and hazardous waste disciplines including Preliminary Assessments, Remedial Investigations, and Feasibility Studies at Superfund sites, RCRA Facility Assessments, Initial Assessment Studies under the Naval Environmental Energy Study Assessment (NEESA), Region IV Compliance investigation for subsequent legal actions, Information Specialist for the EPA/Superfund Hotline, and assisting in the management of REM/FIT zone contracts.

Performed as task leader for the Blue Plains WWTP Biomonitoring Project consisting of laboratory setup, monitoring test organisms, conducting toxicity tests, and preparation of weekly and monthly reports.

EMPLOYMENT

Dynamac Corporation (1988-present): Environmental Scientist

In working for Dynamac's Hazardous Materials Technical Center (HMTC), performs Preliminary Assessments, Remedial Investigations, and Feasibility Studies (PA/RI/FS) under the Air National Guard Installation Restoration Program. Specifically involved in preparing reports detailing site investigation findings, determining rates and extent of contamination, and recommendations for Phase II monitoring and soil sampling.

Participated in a remedial investigation/feasibility study at a Superfund site in Puerto Rico to ascertain the alleged extent of mercury contamination.

C.C. Johnson & Malhotra, P.C. (1985-1988): Environmental Technician

Task leader for the Blue Plains WWTP Biomonitoring Project consisting of laboratory setup, monitoring test organisms, conducting toxicity tests, and preparation of weekly and monthly reports. Participated in groundwater monitoring, well installation and development at Independent Nail, SC, Superfund site. Conducted RCRA Facility Assessments (RFAs) under EPA's REM III Project for Regions I and IV. Performed literature search, site investigations, sample collection, CLP coordination, health and safety plan

preparation, data analysis, and document preparation. Participated on a team involved in the research and organization of compliance documents for subsequent legal actions. Participated in the preparation of an RI/FS consisting of surveying and soil, sediment, surface water and groundwater sampling, groundwater contamination migration determination, and residential well sampling at Geiger C&M Oil, SC, DeRewal, NJ, and Limestone Road, MD, Superfund sites. Assisted in the final preparation of the Initial Assessment Studies under the Navy's hazardous waste control program (NEESA) at three Navy facilities.

Geo/Resource Consultants (1984-1985): Environmental Assistant

Information Specialist for the EPA's RCRA/Superfund Hotline involved in technical assistance regarding federal and state regulations and the requirements necessary for the management of hazardous waste, for industry and the public.

Environmental Protection Agency (1981-1984): Intern

As an environmental intern, assisted Field Investigation Team (FIT) Deputy Project Officers in the management of REM/FIT zone contracts. Specifically involved in the evaluation of completed FIT projects, assistance in the award fee process, evaluation of FIT well drilling procedures, development of analytical documents for RCRA 3012 Cooperative Agreement Program, involving the development of a tracking system of the State agencies use of funds for hazardous waste cleanup.

RAYMOND G. CLARK, JR.

EDUCATION

Completed graduate engineering courses, George Washington University, 1957
B.S., Mechanical Engineering, University of Maryland, 1949

SPECIALIZED TRAINING

Grad. European Command Military Assistance School, Stuttgart, 1969
Grad. Army Psychological Warfare School, Fort Bragg, 1963
Grad. Sanz School of Languages, D.C., 1963
Grad. DOD Military Assistance Institute, Arlington, 1963
Grad. Defense Procurement Management Course, Fort Lee, 1960
Grad. Engineer Officer's Advanced Course, Fort Belvoir, 1958

CERTIFICATIONS

Registered Professional Engineer: Kentucky (#4341); Virginia (#8303); Florida (#36228)

EXPERIENCE

Thirty-one years of experience in engineering design, planning and management including construction and construction management, environmental, operations and maintenance, repair and utilities, research and development, electrical, mechanical, master planning and city management. Over six years' logistical experience including planning and programming of military assistance materiel and training for foreign countries, serving as liaison with American private industry, and directing materiel storage activities in an overseas area. Over two years' experience as an engineering instructor. Extensive experience in personnel management, cost reduction programs, and systems improvement.

EMPLOYMENT

Dynamac Corporation (1986-present): Program Manager/Department Manager

Responsible for activities relating to Preliminary Analysis, Site Investigations, Remedial Investigations, Feasibility Studies, and Remedial Action for the Installation Restoration Program for the U.S. Air Force, Air National Guard, Bureau of Prisons, and the U.S. Coast Guard, including records search, review and evaluation of previous studies; preparation of statements of work, feasibility studies; preparation of remedial action plans, designs and specifications; review of said studies/plans to ensure that they are in conformance with requirements; review of environmental studies and reports; preparation of Air Force Installation Restoration Program Management Guidance; and preparation of Part B permits.

Howard Needles Tammen & Bergendoff (HNTB) (1981-1986): Manager

Responsible, as Project Manager, for: design of a new concourse complex at Miami International Airport to include terminal building, roadway system, aircraft apron, drainage channel relocation, satellite building with underground pedestrian tunnel, and associated underground utility corridors, to include subsurface aircraft fueling systems, with an estimated construction cost of $163 million; a cargo vehicle tunnel under the crosswind runway with an estimated construction cost of $15 million; design and construction of two large corporate jet aircraft hangars; and for the hydrocarbon recovery program to include investigation, analysis, design of recovery systems, monitoring of recovery systems, and planning and design of residual recovery systems utilizing biodegradation. Participated, as sub-consultant, in Air Force IRP seminar.

HNTB (1979-1981): Airport Engineer

Responsibilities included development of master plan for Iowa Air National Guard base; project initiation assistance for a new regional airport in Florida; engineering assistance for new facilities design and construction for Maryland Air National Guard; master plan for city maintenance facilities, Orlando, Florida; in-country master plan and preliminary engineering project management for Madrid, Spain, International Airport; and project management of master plan for Whiting Naval Air Station and outlying fields in Florida.

HNTB (1974-1979): Design Engineer

Responsibilities included development of feasibility and site selection studies for reliever airports in Cleveland and Atlanta; site selection and facilities requirements for the Office of Aeronautical Charting and Cartography, NOAA; and onsite mechanical and electrical engineering design for terminal improvements at Baltimore-Washington International Airport, Maryland.

HNTB (1972-1974): Airport Engineer

Responsible for development of portions of the master plan and preliminary engineering for a new international airport for Lisbon, Portugal, estimated to cost $250 million.

Self-employed (1971-1972): Private Consultant

Responsible for engineering planning and installation of a production line for multimillion-dollar contract in Madrid, Spain, to fabricate transmissions and differentials for U.S. Army vehicles.

U.S. Army, Corps of Engineers (1969-1971): Chief, Materiel & Programs

Directed materiel planning and military training programs of military assistance to the Spanish Army. Controlled arrival and acceptance of materiel by host government. Served as liaison/advisor to American industry interested

in conducting business with Spanish government. Was Engineer Advisor to Spanish Army Construction, Armament and Combat Engineers, also the Engineer Academy and Engineer School of Application.

Corps of Engineers (1968-1969): Chief, R&D Branch, OCE

Directed office responsible to Chief of Engineers for research and development. Developed research studies in new concepts of bridging, new explosives, family of construction equipment, night vision equipment, expedient airfield surfacing, expedient aircraft fueling systems, water purification equipment and policies, prefabricated buildings, etc. Achieved Department of Army acceptance for development and testing of new floating bridge. Participated in high-level Department Committee charged with development of a Tactical Gap Crossing Capability Model.

Corps of Engineers (1967-1968): Division Engineer

Facilities engineer in Korea. Was fully responsible for management and maintenance of 96 compounds within 245 square miles including 6,000+ buildings, 1 million linear feet of electrical distribution lines, 18 water purification and distribution systems, sanitary sewage disposal systems, roads, bridges, and fire protection facilities with real property value of more than $256 million. Planned and developed the first five-year master plan for this area. Administered $12 million budget and $2 million engineer supply operation. Was in responsible charge of over 500 persons. Developed and obtained approval for additional projects worth $9 million for essential maintenance and repair. Directed cost reduction programs that produced more than $500,000 savings to the United States in the first year.

Corps of Engineers (1963-1967): Engineer Advisor

Engineer and aviation advisor to the Spanish Army. Developed major modernization program for Spanish Army Engineers, including programming of modern engineer and mobile maintenance equipment. Directed U.S. portion of construction, testing and acceptance of six powder plants, one shell loading facility, an Engineer School of Application, and depot rebuild facilities for engineer, artillery, and armor equipment. Planned and developed organization of a helicopter battalion for the Spanish Army. Responsible for sales, delivery, assembly and testing of 12 new helicopters in country. Provided U.S. assistance to unit until self-sufficiency was achieved. Was U.S. advisor to Engineer Academy, School of Application and Polytechnic Institute.

Corps of Engineers (1960-1963): Deputy District Engineer

Responsible for planning and development of extensive construction projects in the Ohio River Basin for flood control and canalization, including dam, lock, bridge, and building construction, highway relocation, watershed studies, real estate acquisitions and dispositions. Was contracting officer for more than $75

million of projects per year. Supervised approximately 1,300 personnel, including 300 engineers. Planned and directed cost reduction programs amounting to more than $200,000 per year. Programmed and controlled development of a modern radio and control net in a four-state area.

Corps of Engineers (1959-1960): Area Engineer

Directed construction of a large airfield in Ohio as Contracting Officer's representative. Assured that all construction (runway, steam power plant, fuel transfer and loading facilities, utilities, buildings, etc.) complied with terms of plans and specifications. Was onsite liaison between Air Force and contractors.

Corps of Engineers (1958-1959): Chief, Supply Branch

Managed engineer supply yard containing over $21 million construction supplies and engineer equipment. Directed in-storage maintenance, processing and deprocessing of equipment. Achieved complete survey of items on hand, a new locator system and complete rewarehousing, resulting in approximately $159,000 savings in the first year.

Corps of Engineers (1957-1958): Student

U.S. Army Engineer School, Engineer Officer's Advanced Course.

Corps of Engineers (1954-1957): Engineer Manager

Managed engineer construction projects and was assigned to staff and faculty of the Engineer School. Was in charge of instruction on engineer equipment utilization, management and maintenance. Directed Electronic Section of the school. Coordinated preparation of five-year master plan for the Department of Mechanical and Technical Equipment.

Corps of Engineers (1949-1954): Engineer Commander

Positions of minor but increasing importance and responsibility in engineering management, communications, demolitions, construction administration and logistics.

PROFESSIONAL AFFILIATIONS

Member, National Society of Professional Engineers
Fellow, Society of American Military Engineers
Member, American Society of Civil Engineers
Member, Virginia Engineering Society
Member, Project Management Institute

HARDWARE

IBM PC

SOFTWARE

Lotus 1-2-3, D Base III Plus, Framework, Project Scheduler 5000, Harvard Project Manager, Volkswriter, Microsoft Project

MARK D. JOHNSON

EDUCATION

B.S., Geology, James Madison University, 1980

EXPERIENCE

Eight years' technical and management experience including geologic mapping, subsurface investigations, foundation inspections, groundwater monitoring, pumping and observation well installation, geotechnical instrumentation, groundwater assessment, preparation of Air Force Installation Restoration Program Guidance, preparation of statements of work for environmental field monitoring and feasibility studies for the Air Force and the Air National Guard, development of environmental field monitoring programs, and preparation of Preliminary Assessments for the Air National Guard.

EMPLOYMENT

Dynamac Corporation (1984-present): Senior Staff Scientist/Geologist

Primarily responsible for developing and managing technical support programs relevant to CERCLA related activities for the Air Force, Air National Guard, Department of Justice and Coast Guard. These activities include Statements of Work for Site Investigations (SI), Remedial Investigations (RI), and Feasibility Studies (FS); assessing groundwater at hazardous waste disposal/spill sites for the purpose of determining rates and extents of contaminant migration and for developing SI and RI programs and identifying remedial actions; reviewing SI, RI and FS contractor work plans for various government clients, developing technical and contractual requirements for SI, RI and FS projects, managing the development and preparation of Preliminary Assessments, and assisting clients in the development of their environmental management programs, which included preparation of the Air Force's Installation Restoration Program Management Guidance document.

Bechtel Associates Professional Corporation (1981-1984): Geologist

Performed the following duties in conjunction with major civil engineering projects including subways, nuclear power plants and buildings: prepared geologic maps of surface and subsurface facilities in rock and soil including tunnels, foundations and vaults; assessed groundwater conditions in connection with construction activities and groundwater control systems; monitored the installation of permanent and temporary dewatering systems and observation wells; monitored surface and subsurface settlement of tunnels; and participated in subsurface investigations.

Schnabel Engineering Associates (1981): Geologist

Inspected foundations and backfill placement.

PROFESSIONAL CREDENTIALS

Registered Professional Geologist, South Carolina, #116, 1987

PROFESSIONAL AFFILIATIONS

Association of Engineering Geologists
National Water Well Association/Association of Ground Water Scientists and Engineers

Appendix B

Outside Agency Contact List

OUTSIDE AGENCY CONTACT LIST

1. U.S. Geological Survey
   Library and Map Sales
   12201 Sunrise Valley Drive
   Reston, Virginia 22092
   (703) 648-4000

2. Tennessee Wildlife Resources Agency
   Ellington Agriculture Center
   Nashville, Tennessee 37204
   Robert M. Hatcher
   (615) 781-6610

3. National Oceanic and Atmospheric Administration
   6010 Executive Boulevard
   Rockville, Maryland 20852
   (301) 443-8910

4. Soil Conservation Service
   P.O. Box 22
   7777 Walnut Grove Road
   Memphis, Tennessee 38119
   (901) 577-7650

5. Memphis Light, Gas, and Water Division (MLGW)
   220 South Main Street
   Memphis, Tennessee 38101
   Tommy Whitlow
   (901) 523-0711

6. City Engineering
   125 North Main Street
   Memphis, Tennessee 38103
   (901) 576-6690

7. County Engineering
   160 North Main Street
   Memphis, Tennessee 38103
   (901) 576-4320

8. United States Department of the Interior
   Fish and Wildlife Service
   Division of Ecological Services
   P. O. Box 845
   Cookeville, Tennessee 38503-0845
   (615) 528-6481

OUTSIDE AGENCY CONTACT LIST (continued)

9. Browning-Ferris of Tennessee Industries
   3840 Homewood
   Memphis, Tennessee 38118
   (901) 793-3800

Appendix C

USAF Hazard Assessment Rating Methodology

USAF HAZARD ASSESSMENT RATING METHODOLOGY

The Department of Defense (DoD) has developed a comprehensive program to identify, evaluate, and control hazardous waste disposal practices associated with past waste disposal techniques at DoD facilities. One of the actions required under this program is to:

> Develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the U.S. Air Force has sought to establish a system to set priorities for taking further action at sites based upon information gathered during the Preliminary Assessment phase of the Installation Restoration Program.

PURPOSE

The purpose of the site rating model is to assign a ranking to each site where there is suspected contamination from hazardous substances. This model will assist the Air National Guard in setting priorities for follow-up site investigations.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazard waste present in sufficient quantity), and (2) potential for migration exists. A site may be deleted from ranking consideration on either basis.

DESCRIPTION OF THE MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DoD needs.

The model uses data readily obtained during the Preliminary Assessment portion of the IRP. Scoring judgment and computations are easily made. In assessing

the hazards at a given site, the model develops a score based on the most likely routes of contamination and worst hazards at the site. Sites are given low scores only if there are clearly no hazards. This approach meshes well with the policy for evaluating and setting restrictions on excess DoD properties.

Site scores are developed using the appropriate ranking factors presented in this appendix. The site rating form and the rating factor guidelines are provided at the end of this appendix.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: (1) possible receptors of the contamination, (2) the waste and its characteristics, (3) the potential pathways for contaminant migration, and (4) any effort that was made to contain the waste resulting from a spill.

The receptors category rating is based on four rating factors: (1) the potential for human exposure to the site, (2) the potential for human ingestion of contaminants should underlying aquifers be polluted, (3) the current and anticipated use of the surrounding area, and (4) the potential for adverse effects upon important biological resources and fragile natural settings. The potential for human exposure is evaluated on the basis of the total population within 1000 feet of the site, and the distance between the site and the base boundary. The potential for human ingestion of contaminants is based on the distance between the site and the nearest well, the groundwater use of the uppermost aquifer, and population served by the groundwater supply within 3 miles of the site. The uses of the surrounding area are determined by the zoning within a 1-mile radius. Determination of whether or not critical environments exist within a 1-mile radius of the site predicts the potential for adverse effects from the site upon important biological resources and fragile natural settings. Each rating factor is numerically evaluated (0-3) and increased by a multiplier. The maximum possible score is also computed. The factor score and maximum possible scores are totaled, and the receptors subscore computed as follows: receptors subscore = (100 X factor subtotal/maximum score subtotal).

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst

case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score while scores for solids are reduced.

The pathways category rating is based on evidence of contaminant migration along one of three pathways: surface water migration, flooding, and groundwater migration. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned, and for direct evidence, 100 points are assigned. If no evidence is found, the highest score among the three possible routes is used. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The scores for each of the three categories are added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Scores for sites with no containment are not reduced. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well-managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the score for the other three categories.

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 ft. of site		4		12
B. Distance to nearest well		10		30
C. Land use-zoning within 1 mile radius		3		9
D. Distance to installation boundary		6		18
E. Critical environments within 1 mile radius of site		10		30
F. Water quality of nearest surface water body		6		18
G. Groundwater use of uppermost aquifer		9		27
H. Population served by surface water supply within 3 miles downstream of site		6		18
I. Population served by groundwater supply within 3 miles of site		6		18
		Subtotals	______	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______

2. Confidence level (C = confirmed, S = suspected) ______

3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

______ x ______ = ______

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

______ x ______ = ______

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		24
Net precipitation		6		18
Surface erosion		8		24
Surface permeability		6		18
Rainfall intensity		8		24
Subtotals			______	108

Subscore (100 x factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		3

Subscore (100 x factor score/3) 0

3. Groundwater migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to groundwater		8		24
Net precipitation		6		18
Soil permeability		8		24
Subsurface flows		8		24
Direct access to groundwater		8		24
Subtotals			______	114

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway score
Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors
Waste Characteristics
Pathways

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

______ x ______ = ______

I. **RECEPTORS CATEGORY**

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1-25	26-100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land use/zoning (within 1-mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1-mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands	10
F. Water quality/use designation of nearest surface water body	Agricultural or Industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies	6
G. Groundwater use of uppermost aquifer	Not used, other sources readily available	Commercial Industrial, or Irrigation, very limited other water sources	Drinking water, municipal water available	Drinking water, no municipal water available, commercial, industrial, or irrigation; no other water source available	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1-50	51-1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1-50	51-1,000	Greater than 1,000	6

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records
- o Knowledge of types and quantities of wastes generated by shops and other areas on base

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

A-3 Hazard Rating

Rating Factors	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability, and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
	L	C	H
80	H	C	H
70	L	S	H
	S	C	H
60	H	C	H
	L	S	H
	L	C	L
50	H	S	H
	S	C	H
	S	S	H
	H	S	H
40	H	C	L
	L	S	L
	S	C	L
30	H	S	L
	S	S	H
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added.
- o Suspected confidence levels (S) can be added.
- o Confirmed confidence levels cannot be added with suspected confidence levels.

Waste Hazard Rating
- o Wastes with the same hazard rating can be added.
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCH if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCH (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Multiply Point Rating Persistence Criteria	From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical state	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, groundwater, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or report discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 Potential for Surface Water Contamination

Rating Factors	0	1	2	3	Multipli
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to a mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($>10^{-6}$ cm/sec)	6
Rainfall intensity based on 1-year, 24 hour rainfall (thunderstorms)	<1.0 inch 0-5 0	1.0 to 2.0 inches 6-35 30	2.1 to 3.0 inches 36-49 60	>3.0 inches >50 100	8

B-2 Potential for Flooding

Rating Factors	0	1	2	3	Multipli
Floodplain	Beyond 100-year floodplain	In 100-year floodplain	In 10-year floodplain	Floods annually	1

B-3 Potential for Groundwater Contamination

Rating Factors	0	1	2	3	Multipli
Depth to groundwater	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay 10^{-2} to 10^{-4} cm/sec	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high groundwater level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean groundwater level	8
Direct access to groundwater (through faults, fractures, faulty well casings, subsidence, fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. Waste Management Practices Factor

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Protection Training Areas:

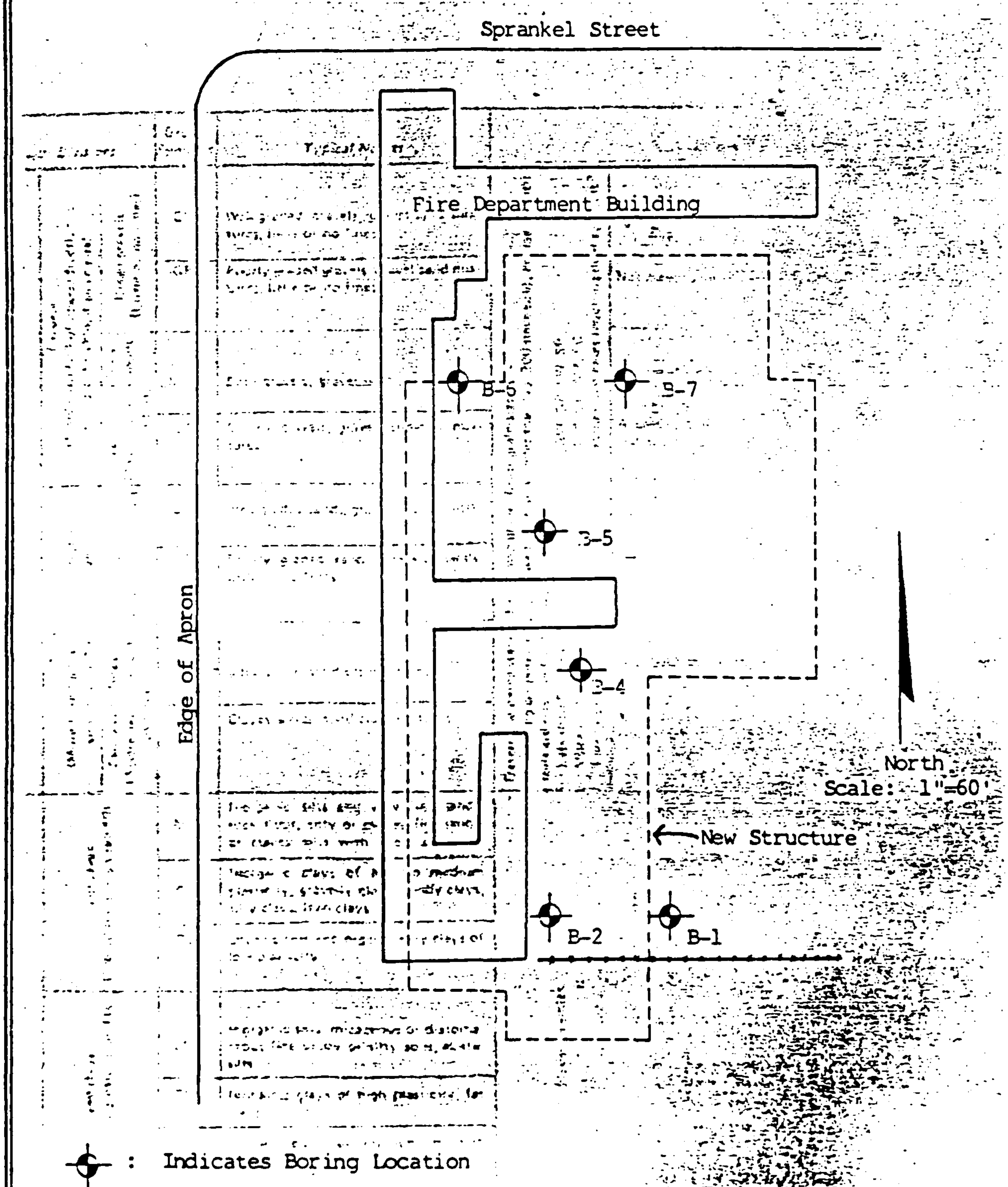
- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-B-3, then leave blank for calculation of factor score and maximum possible score.

Appendix D

Soil Borings

TEST, Inc.

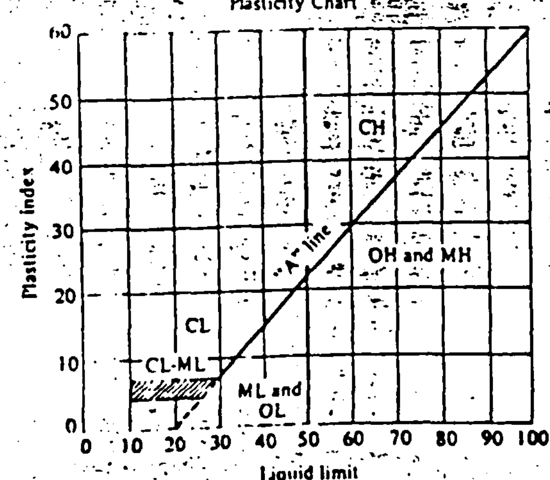


PROJECT NAME Composite Squadron Operations Facilities Tennessee Air National Guard Memphis, Tennessee	BORING LOCATION PLAN
PROJECT NO 502-35132	DATE November, 1983

SOIL CLASSIFICATION CHART - ASTM D2487

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent: GW, GP, SW, SP; More than 12 per cent: GM, GC, SM, SC; 5 to 12 per cent: *Borderline cases requiring dual symbols*	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline cases requiring use of dual symbols*
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	Plasticity Chart (see below)		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt	Peat and other highly organic soils			

Plasticity Chart



CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	Penetration Resistance, N*	Consistency
SAND AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	50+	Very Dense

	Penetration Resistance, N	Relative Density
SILTS AND CLAYS	0 - 2	Very Soft
	3 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	30+	Hard

*N: Indicates Standard Penetration Resistance, Blows Per Foot (ASTM D-1586)

TEST BORING RECORD

TEST inc. ENGINEERING LABORATORIES
4161 RIDGEMOOR AVENUE
MEMPHIS, TENN. 38118
PHONE 365-1802

Date Drilled 10-28-83 — Job No. 502-35132

Project: Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface — Boring No. B-1

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	ML	Stiff to Soft Grayish Brown Very Clayey SILT		4-6-6	23.1	Approximately 4 inches of asphaltic pavement at surface.
		- Very Clayey		3-5-8	19.7	
5				3-3-4	28.3	c=0.6 ksf (Vane Shear) c=0.42 ksf @ 2.6% strain
				2-2-4	24.3	
10				3-4-6	23.8	
15				3-3-3	30.1	
20				3-3-4	19.7	
25	SC/SM	Medium Dense Very Dark Gray-Black Clayey SAND and SAND		7-6-6	9.3	No free ground water was encountered during drilling and the hole was dry upon completion.
30	SP/SM	Dense Brown Light Gray and Tan SAND With Silty Sand Seams & Fine Gravel		11-11-22	8.9	Shelby tube sample was taken from a boring immediately adjacent to this boring.
35		Boring Terminated @ 30.5'				

N = No. Blows for 140-Lb. Hammer falling 30 inches
w = Moisture Content, per cent
( ) Hrs. after completion of Boring for water level
Water Level — Water encountered during drilling
Split-Spoon Sample — Shelby Tube Sample — Sample not recovered

TYPE OF DRILLING:
- ☒ Hollow-Core Auger
- ☐ Hydraulic Rotary
- ☐ Hand Auger

Sheet 1 of 1

TEST inc. ENGINEERING LABORATORIES 4161 RIDGEMOOR AVENUE MEMPHIS, TENN. 38118 PHONE 365-1802

TEST BORING RECORD

Date Drilled 10-31-83 Job No. 502-35132

Project Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface Boring No. B-2

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	ML	Stiff to Soft Gray and Brown Clayey SILT		5-7-7	19.5	
		- More Cohesive		3-3-6	22.6	
5				1-1-2	21.1	c=0.6 ksf (Vane Shear) c=0.81 ksf @ 5.2% strain
				3-5-6	24.0	
10		- More Cohesive		3-3-4	24.5	
15				2-3-4	28.9	
20	CL	Soft Brownish Gray Silty CLAY		2-2-2	22.5	
25	SP	Medium Dense Gray Fine SAND		6-8-12	8.9	
30	SP	Dense Reddish Brown Gravelly SAND With Trace Silt		11-16-18	10.1	
35	SP	Dense White Gravelly SAND	(0)	27-22-30	17.9	The hole was dry at least 24 hours later, but had caved-in at a depth of about 28.0 feet.
40				10-24-50	12.6	

Boring Terminated @ 40.5'

N = No. Blows for 140-Lb. Hammer falling 30 inches

w = Moisture Content, per cent

( ) Hrs. after completion of Boring for water level

Water Level — Water encountered during drilling

Split-Spoon Sample — Shelby Tube Sample — Sample not recovered

TYPE OF DRILLING:

- ☒ Hollow-Core Auger
- ☐ Hydraulic Rotary
- ☐ Hand Auger

TEST BORING RECORD

TEST inc.
ENGINEERING LABORATORIES
4161 RIDGEMOOR AVENUE
MEMPHIS, TENN. 38118
PHONE 365-1802

Date Drilled 10-28-83 Job No. 502-35132

Project Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface Boring No. B-4

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	SC	Medium Dense Red Clayey SAND and GRAVEL		12-12-15	5.0	Approximately 3 inches of asphaltic pavement at surface
	ML	Stiff to Soft Grayish Brown Clayey SILT		5-6-7	18.0	
5				2-1-2	25.1	c=0.8 ksf (Vane Shear) c=0.78 ksf @ 6.9% strain
				3-5-8	25.0	
10				3-4-5	28.7	
15				2-1-2	31.6	
20				2-3-3	21.3	
25	ML	Firm Dark Gray-Black Clayey Sandy SILT		5-2-3	27.4	No free ground water was encountered during drilling and the hole was dry upon completion.
30	SM	Very Dense Tan Gravelly SAND With Trace Silt		19-30-24	6.2	Shelby tube sample was taken from a boring immediately adjacent to this boring.
		Boring Terminated @ 30.5'				
35						

N = No. Blows for 140-Lb. Hammer falling 30 inches
w = Moisture Content, per cent
( ) Hrs. after completion of Boring for water level
Water Level ∇ Water encountered during drilling
Split-Spoon Sample Shelby Tube Sample Sample not recovered

TYPE OF DRILLING:
- ☒ Hollow-Core Auger
- ☐ Hydraulic Rotary
- ☐ Hand Auger

TEST inc.
ENGINEERING LABORATORIES
4161 RIDGEMOOR AVENUE
MEMPHIS, TENN. 38118
PHONE 365-1802

TEST BORING RECORD

Date Drilled 10-31-83 Job No. 502-35132

Project Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface Boring No. P-5

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	CL/ML	Stiff to Soft Grayish Brown Very Silty CLAY		5-8-8	19.4	Approximately 3 inches of asphaltic pavement at surface
				2-3-3	23.6	
5				2-1-2	24.4	
				4-5-7	24.1	
10				4-5-6	25.3	
15				2-3-4	28.1	
20				2-3-4	21.0	
25	SP	Medium Dense Fine Gray SAND		5-8-12	9.0	The hole was dry at least 24 hours later, but had caved-in at a depth of about 27.0 feet.
30	SP	Dense White Gravelly SAND With Trace Silt	(0)	12-10-23	8.6	
35	SP	Very Dense to Dense Reddish Brown to Brown Gravelly SAND With Trace Silt		12-24-44	11.6	
40				12-14-21	15.4	

Boring Terminated @ 40.5'

N = No. Blows for 140-Lb. Hammer falling 30 inches

w = Moisture Content, per cent

( ) Hrs. after completion of Boring for water level

Water Level — Water encountered during drilling

Split-Spoon Sample — Shelby Tube Sample — Sample not recovered

TYPE OF DRILLING:

- ☒ Hollow-Core Auger
- ☐ Hydraulic Rotary
- ☐ Hand Auger

TEST BORING RECORD

TEST inc.
ENGINEERING LABORATORIES
4161 RIDGEMOOR AVENUE
MEMPHIS, TENN. 38118
PHONE 365-1802

Date Drilled 10-28-83 Job No. 502-35132

Project Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface Boring No. B-6

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	ML	Stiff to Soft Brownish Gray Clayey SILT		5-5-8	22.2	
		- More Cohesive		4-6-8	22.0	
5		- With Black Thin Organic Seams		3-4-4	20.3	
				2-1-2	23.8	c=0.8 ksf (Vane Shear)
10				2-2-2	24.8	
15				2-2-4	30.7	
20				2-4-4	20.8	
25	ML	Stiff Dark Gray-Black Clayey Sandy SILT		2-3-6	31.8	
30	SP SM	Dense Tan Gravelly Silty SAND		12-17-15	5.3	
		Boring Terminated @ 30.5'				No free ground water was encountered during drilling and the hole was dry upon completion.
35						

N = No. Blows for 140-Lb. Hammer falling 30 inches
w = Moisture Content, per cent
( ) Hrs. after completion of Boring for water level
Water Level — Water encountered during drilling
Split-Spoon Sample — Shelby Tube Sample — Sample not recovered

TYPE OF DRILLING:
- [x] Hollow-Core Auger
- [ ] Hydraulic Rotary
- [ ] Hand Auger

TEST inc.
ENGINEERING LABORATORIES
4161 RIDGEMOOR AVENUE
MEMPHIS, TENN. 38118
PHONE 365-1802

TEST BORING RECORD

Date Drilled 10-31-83 | Job No. 502-35132

Project Composite Squadron Operations Facilities
Tennessee Air National Guard
Memphis, Tennessee

Elev. N/A @ Surface | Boring No. B-7

DEPTH	LOG	DESCRIPTION	ELEV.	N/6"	w	No topographic information has been provided.
0	CL	Stiff Brown Very Silty CLAY		5-7-9	21.2	Approximately 3 inches of asphaltic pavement at surface
				4-8-8	21.3	
5	ML	Stiff to Soft Grayish Brown Clayey SILT		3-4-5	25.1	
				2-3-6	24.0	
10				3-4-6	24.2	
15				4-5-5	27.0	
20				2-2-2	20.1	
25	SP	Dense Gray Fine SAND		5-15-20	6.8	
30	SP/SM	Dense to Very Dense White to Tan Gravelly SAND With Trace Silt		10-20-22	18.0	
35			(0)	8-20-24	14.3	The hole was dry at least 24 hours later, but had caved-in at a depth of about 26.0 feet.
40		- Reddish Brown		10-30-50/5"	19.2	

Boring Terminated @ 40.5'

N = No. Blows for 140-Lb. Hammer falling 30 inches
w = Moisture Content, per cent
( ) Hrs. after completion of Boring for water level
Water Level   Water encountered during drilling
Split-Spoon Sample   Shelby Tube Sample   Sample not recovered

TYPE OF DRILLING:
- ☒ Hollow-Core Auger
- ☐ Hydraulic Rotary
- ☐ Hand Auger

Appendix E

Underground Tanks

Underground Storage Tank Inventory,
164th TAG, Tennessee Air National Guard,
Memphis International Airport, Memphis, Tennessee

Location	Bldg 9	Bldg 9	Bldg 9	Bldg 12
Capacity (gallons)	4,200	4,200	6,100	8,000
Contents	MOGAS	MOGAS	Diesel	Diesel
Year Installed	1965	1970	1982	1968
Material of Construction	Steel	Steel	Steel	Steel
Coatings A. Interior B. Exterior	 Uncoated Painted	 Uncoated Painted	 Uncoated Painted	 Uncoated Painted
Cathodic Protection	None	None	None	None
Status of Tank (year Abandoned)	Active	Active	Active	1980
Latest Inspection Date	1979	1979	1979	----
Secondary Containment	None	None	None	None